THE WILD FERNS OF MADRAS CITY
AND ITS IMMEDIATE NEIGHBOURHOOD

M. S. CHANDRASEKHAR

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OF THE

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EDITED BY THE DIRECTOR OF MUSEUMS

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BY

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(Published - 1972)

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EDITOR'S PREFACE

Books on Indian ferns are few and far between. Many of the standard works, hither-to consulted, have become out of date. It has therefore remained a long-felt need to bring out books on this difficult group of plants; and this volume endeavours to make a beginning in this regard, confining itself to Madras City and its immediate surroundings. The actual area of coverage is defined in the author's introduction.

The author has been devoting a great deal of his time and energies on this work amidst his other multifarious curatorial duties for the past several years and it is a matter of great satisfaction that in preparing this comprehensive bulletin conforming, as far as possible, to currently accepted standards and system of classification, he has been able to make a valuable contribution to the literature on the flora of Madras City and its vicinity.

Since this volume is intended to cater not only to the needs of students and teachers but also to the needs of all those interested in Botany, a glossary has been included for the technical terms used.

Our thanks are immensely due to the professors of the City colleges and the Director of the Botanical Survey of India, for their whole-hearted co-operation in the prosecution of this work.

Madras.
June, 1968.

S. T. SATYAMURTI
Director of Museums.

INTRODUCTION

This publication deals with only those ferns which grow wild, or are reported to have been found growing so, in and around Madras City. Plants not found wild by the writer, have been indicated at the appropriate places in the text. The area covered by this work, roughly extends upto 80 km. to the west, 80 km. to the south, and 90 km. to the north, of Madras City, the eastern limit being the sea-shore. It is a vast plain the monotony of which is beguiled a little by the relic hillocks that are seen studded here and there. In the north however the Nagaris offer a paradise to the plant-collectors. They present at Kambakam Village several slopes in several directions, become an important water-shed with luxurious vegetation, and provide ideal conditions for the growth of ferns of different habitats. Shooting up *almost vertically* to the height of 762 m. above mean sea level, they provide at *that* village unique facilities for studying the plants not only in different environs but also at different elevations. Almost all the ferns, described in this work, hail therefore from there.

Frequent exploratory trips to a number of localities in the area were made, and on-the-spot observations were recorded and consolidated to form the foundation for this work.

It is interesting to observe that some of the species collected by other botanists in the past, are not available now in the area, or (if available) are scarce. The easily-attributable reason is the attention the area has received from the local colleges, their over-zealous students, and the disappearance of large trees.

Ferns have in their life-history a distinct alternation of generations in which the sporophytes are more conspicuously and elaborately developed than the gametophytes which are so small that they have not been studied yet in several cases. This publication is intended only to be of help in the identification of the sporophytes of the ferns in the area. It therefore describes only the sporophytes. The gametophytes are referred to only very briefly, and that too, only when a mention of it is considered a desirable addendum.

The same reasons explain also the provision of an artificial key for identification of the ferns in the area, which is based only on the characters of the sporophytes.

The classification of ferns has been changing from time to time, owing largely to the new discoveries that are frequently made with the help of improved equipments, and in no less degree to the multifarious diversities in the characters of these plants themselves. Further, parallel and divergent Evolution appears to have been the rule with the ferns; and it has created numerous problems which are yet to be satisfactorily solved for the establishment of an acceptable natural system of classification for them (ferns). In other words, no finality has been reached yet in the classification of these plants. In this book, Pichi-Sermolli's system of classification as subsequently modified by the various other authors (cited in the Bibliography), and as would suit the local situations, is followed. This work marks off the disputed items, wherever necessary, and does not go into controversies. For more detailed information the authorities cited in the Bibliography, may be consulted.

Attempts have been made wherever the relevent data are available, to include the economic importance of the plants under description. Should any information of this kind is wanting in respect of any species in this work, it is so not because it is unimportant, but because it could not be had. As all plants serve man in their own way, information that can fill up these omissions can, no doubt, be there, and if sent, will be thankfully received at the Government Museum, Madras 8.

Every effort has been made to ascertain and incorporate the names of these plants in Tamil which is the language of the State. But information in this regard is wanting in common parlance, in the case of almost all these plants. To get over this difficulty the principle followed in the Government List of Technical and Scientific Terms, 1947 are adopted in finding the

Tamil equivalents which are furnished in Appendix V. Besides, the English popular name or the (Latin) scientific name, whichever is comparatively easier, has been freely translated into Tamil in accordance with the meaning broadly conveyed by it, in respect of each fern. These newly-coined names in Tamil may lack in history and popular usage. But, they are included here and shown within brackets (Appendix V), only till popularly-understood names evolve out and replace them, or till they themselves become popular.

This being a museum publication it is considered highly desirable to include a few words for the guidance of fern-collectors. As a detailed note will make a separate publication, only a few hints, specially peculiar to the collection and preservation of the ferns mentioned in this work, are furnished in Appendix I. For more details other works may be referred to, or the Director of Museums, Madras 8 may be addressed.

It has been found necessary during the execution of this work, to use "jargons" some of which are not in common use, and some of which have been rather invented to achieve brevity without sacrificing clarity. Hence a glossary is furnished in Appendix III, in which the terms are defined but only to the extent necessary to understand the text. The description of the different genera and species, is presented in the style adopted in most other botanical works of this kind.

The authors' names that follow the plant names, have been abbreviated only on the universally-accepted lines. Nevertheless the expanded forms are given in Appendix IV.

I could not have completed this work but for the persistent encouragement received from Dr. A. Aiyappan, (former) Superintendent, Government Museum, Madras and his successor-in-Office, Dr. S. T. Satyamurti, Director of Museums, Government Museum, Madras. This work was considerably helped by the access to important literature on the subject, so kindly made available by Prof. Dr. Rodolfo E. G. Pichi-Sermolli of the Genova University, Genova; the late Rev. Fr. Dr. H. Santapau of the Botanical Survey of India, Calcutta; Prof. Dr. B. G. L. Swamy of the Presidency College, Madras; and numerous officials of the various libraries and sister departments of the Government of Tamil Nadu, Madras. Prof. Dr. R. E. Holttum of London has very kindly dispelled certain fears of mine concerning **Cheilanthes mysurensis**. Unresticted permission from the professors of Botany in the colleges in Madras City and Tambaram, to consult their herbaria, was made full use of. Assistance to face hardship during my tours came largely from Thiru J. D. Chelliah, (now) Microfilm Operator of this Museum, besides a number of other members of the Staff. I have depended mainly on my Technical Assistant, Thiru D. I. Victor for the sketches. I have received helpful comments from Thiru K. Lakshminarayanan, Bronze Gallery Guide of this Museum, in coining the Tamil names for the ferns. To them all, I record here my deep sense of gratitude.

M. S. CHANDRASEKHAR

ARTIFICIAL KEY FOR IDENTIFICATION

1. Ferns floating on or in water ... 2
1. Ferns growing on wet or dry soils or on other plants or supports ... 3

2. Ferns floating free; fronds minute and densely imbricate **Azolla pinnata** (p. 43)
2. Ferns rooted in mud; fronds divided ... 8

3. Fronds simple, but if divided then sterile pinnae simple; margin entire or nearly so ... 4
3. Fronds pinnatifid, or pinnately or dichotomously dividing or forking ... 7

4. Sporangia on narrow spike arising from the base of the sterile part of the lamina **Ophioglossum nudicaule** (p. 15)
4. Sporangia not on spike or any other similar structure ... 5

5. Lamina long, narrow and grass-blade-like; sporangia in linear sori, marginal or parallel to margin, and sunken in grooves ... **Vittaria elongata** (p. 29)
5. Lamina otherwise ... 6

6. Stipe very long and shining; sporangia following reticulate veins **Hemionitis arifolia** (p. 26)
6. Stipe not very long and not shining; sporangia in orbicular sori in a single row on either side the costa and on included veinlets ... **Pleopeltis linearis** (p. 38)

7. Segments of fronds four and arranged clover-like 8
7. Segments of fronds otherwise in number and arrangement ... 9

8. Sporocarps more than one per node, normal and ovoid; sterile pinnules without streaks **Marsilea minuta** (p. 40)
8. Sporocarps only one per node; normal and oblong-ovate; sterile pinnules with streaks of interstitial sclerenchyma ... **Marsilea coromandelica** (p. 41)

9. Sori superficial ... 10
9. Sori marginal, or near the margin, or arranged like a spike or strobilus ... 13

10. Sori linear 11
10. Sori orbicular 18

11. Sori oblique to costa, close to and near the margin, but not extending to costa; sporangia in two rows; huge ferns with fleshy stipule-like outgrowths at the bases of fronds ... **Angiopteris evecta** (p. 16)
11. Sori apparently parallel to the costa and margins ... 12

12. Frond apparently palmately divided or fan-shaped **Actiniopteris radiata** (p. 21)
12. Frond pinnatifid or pinnate; sorus nearer the costa than the margin **Blechnum orientale** (p. 36)

13. Sporangia in marginal sori or near the margin 14
13. Sporangia in spike, or strobilus, or the like arrangement ... 19

14. Indusium extrose; sori usually contiguous; fronds not clustered; veins anastomosing marginally... **Lindsaea ensifolia** (p. 31)
14. Indusium or pseudo-indusium introse; fronds clustered; stipe dark and shining; veins free ... 15

15. Sori on the reflexed lobe of the frond; segments dimidiate on the basiscopic side ... **Adiantum caudatum** (p. 28)
15. Sori not on the reflexed lobe but on the vein-ends; ultimate segments pinnatifid ... 16

16. Fronds tripinnate; pinnules on the basiscopic side of the pinna bigger and longer than those on the acroscopic side **Cheilanthes tenuifolia** (p. 24)
16. Fronds bipinnate ... 17

17. Ambitus of fronds linear-oblong, and tapering at both ends; proximal pinnae diminishing in size and number towards the base **Cheilanthes mysurensis** (p. 23)
17. Ambitus of fronds deltoid-lanceolate, and cordate; basiscopic pinnules of the lowest proximal pinnae enlarged; lowest pinnules of the basal pinnae deeply lobate **Cheilanthes farinosa** (p. 25)

18. Fronds dichotomously divided, often with a dormant bud and a pair of stipule-like outgrowths at the point of division; divisions only slightly unequal at the forking; ultimate divisions without accessory leaflets, and about 6 cm. broad; costules at intervals of less than 5 mm., veins free, and generally furcate above the base ... **Dicranopteris linearis** var. **linearis** (p. 34)
18. Fronds not dichotomously divided, but pinnatifid or pinnate; veins anastomosing and forming one or two rows of sub-hexagonal costal areolae **Pleopeltis linearis** (p. 38)

19. Sporangia arranged strobilus-like on marginal lobes, and indusiate; indusia scale-like; veins free; ferns scandent **Lygodium scandens** (p. 19)
19. Sporangia not arranged on marginal strobili but on narrow spike arising from the base of sterile part of the frond; and exindusiate; veins reticulate; ferns not scandent **Ophioglossum nudicaule** (p. 15)

THE PLANT KINGDOM

The Plant Kingdom is split up into a number of divisions which are placed conveniently in two subkingdoms, viz., Thallobionta and Cormobionta. The former subkingdom comprises the divisions of plants that have no *true* leaves, *true* roots, *true* stems, flowers, fruits nor seeds which are required for a subaerial existence. The latter subkingdom comprises the divisions of plants that possess (with a few exceptions) *true* roots, *true* stems, and *true* leaves endowed with the systems of absorption, transpiration and cutinisation, and with vascular strands; and that are therefore adapted to a subaerial existence. Besides these, these plants possess two kinds of generations, viz., the haploid gametophytic generation and the diploid sporophytic generation, alternating with each other in their life-history. They produce multicellular sporangia with one or more protective layers of sterile cells. They have a heterogamous mode of reproducing themselves sexually. Their antheridia and archegonia are multicellular and have each a protective wall of sterile cells. The fertilized egg develops into an empbryo which is retained, nourished and protected or sufficiently provided for, by the parent plant, till it can lead a free and independent life.

The divisions of the Cormobionta are arranged in two groups, viz., Bryophytonta which have no vascular strands, and Stelophytonta which have them in the sporophytic generation. The gametophytes of the Bryophytonta are quite conspicuous and prominently developed; whereas those of the Stelophytonta are inconspicuous and sometimes reduced to the level of parasites on the much bigger and structurally more complicated sporophytes.

The Stelophytonta is composed of two divisions, viz., Pteridophyta and Spermatophyta. The latter includes in its fold all those plants which reproduce themselves through the production of seeds; the primary root in their case has an axial or polar origin from the embryo. It consists of a few subdivisions which are however separated and raised to the level of full-fledged divisions by some authors. The Division Pteridophyta includes plants which produce no seed as normally understood by that term (seed). The primary root in their case has lateral origin from the embryo.

The Division Pteridophyta comprises six classes of plants, viz., Lycopsida, Sphenopsida, Noeggerathiopsida, Psilotopsida, Psilophytopsida and Filicopsida. The Class Lycopsida consists of plants with simple vascular strands, dichotomously dividing roots, and much-reduced and spirally-arranged leaves. The Class Sphenopsida consists of plants with simple vascular strands, branch-gaps in the stele, jointed stems, much-reduced leaves, and compactly-arranged sporangia which form strobili. The Class Psilotopsida consists of plants with small rhizomes, delicate and branched aerial stems, and minute bilobate spore-bearing leaves; they have no true roots, however. The Class Noeggerathiopsida and the Class Psilophytopsida include only fossil forms with which this work is not concerned. The Class Filicopsida consists of plants with complex vascular strands. They have leaf-gaps in addition to branch-gaps in the stele. The leaves are bigger and more elaborately developed and more complicated than those in the preceding classes. The sporangia are carried only on the dorsal surface or margins of the leaves but not on the ventral surface, unlike those of the preceding classes. The Class Filicopsida forms the subject matter of this work to the extent of their occurrence in Madras City and its immediate neighbourhood.

Class Filicopsida

The Class Filicopsida includes what are commonly known as the ferns which have in their life-history a distinct alternation of generations of sporophyte and gametophyte. The

sporophytes are more conspicuously and elaborately developed than the gametophytes which are too small to be easily observed. The plant propagates itself by spores generally, and by vegetative buds sometimes. The fronds of the sporophytes are larger and more conspicuous, and have a more complicated structure, in relation to the axis. The spores are asexually produced, and from each spore a gametophyte develops. The gametophyte of Filicopsida is known as a prothallus, and may be of three general kinds: (a) photosynthetic and terrestrial or epiphytic; or (b) saprophytic and subterranean; or (c) parasitic on the spore. The parasitic prothallus is seen only in the heterosporous ferns. The prothallus produces antheridia and archegonia. The female gametes (or eggs) are produced in the archegonia. The antheridia produce and liberate the male gametes (spermatozoids) which are multiciliate, and which swim their way freely in water to the archegonium and fertilize the female gamete contained in it. The fertilized female gamete grows up as the sporophyte.

The Class Filicopsida is made up of seven subclasses, viz., Primofilicidae, Ophioglossidae, Marattiidae, Osmundidae, Filicidae, Marsileidae and Salviniidae. Of these the first comprises only fossil forms, and the fourth is not represented in the area.

Subclass Ophioglossidae

The members of the Subclass Ophioglossidae are generally terrestrial, and sometimes epiphytic, herbs. The axis is a slow-growing and creeping rhizome or an erect stock. It is short and succulent and remains underground. It is generally glabrous and sometimes hairy, but never scaly. It has a protostele when young, which later develops into an ectophloic siphonostele. The roots are succulent. The vernation, unlike that of the majority of ferns, is not circinate but erect. The fronds may be only one or more in number, stipitate, and simple or divided into a ventral fertile part, and a dorsal sterile part. These two parts may be further divided variously, or remain simple. There are no stipule-like outgrowths at the bases of the fronds; the sheathing base of the preceding frond protects the following frond. The sporangia arise from groups of subepidermal cells, and are arranged in two rows on a vertical spike which originates from near the base of the lamina. The spike may be compact, simple or divided, and generally stalked but sometimes sessile. It is believed to represent a union of basal pair of pinnae. The sporangia are large, thick-walled, minutely stalked or sessile or sunken, and without annulus. The sporangial wall is of four or five layers of cells in thickness. Numerous tetrahedral spores of one and the same kind are produced. They have no perispore. The prothallus is tuberous and saprophytic with little or no chlorophyll, grows underground, and exhibits mycorrhiza. The antheridia are sunk in the prothallial tissue.

This Subclass comprises only one order, viz., Ophioglossales.

ORDER OPHIOGLOSSALES

Characters of the Order are the same as for the Subclass. Only one family is included, viz., Ophioglossaceae.

Family Ophioglossaceae

Characters of this Family are the same as for the Order. Three distinct and two dubious genera are included in it, but only one occurs in the area.

GENUS OPHIOGLOSSUM L.

Adder's Tongues

Syn.:- *Ophioderma* (Bl.) Endl., and *Cheiroglossa* Pr.

Axis an erect and short stock, usually succulent, with ectophloic siphonostele broken up into dictyostele by large leaf-gaps. Roots succulent. Fronds only few at a time, erect or

pendulous, simple or once or twice pinnately furcate, without stipule-like outgrowths at the base; segments dimorphous; sterile segments simple, entire and almost succulent; fertile segments in the form of a compact spike, rarely furcate. Venation reticulate with orbicular or elongate areolae. Sporangia uniseriate along each margin, large, globose, and sunken on a spike which is generally simple, with a terete stalk. Dehiscence transverse. Spores tetrahedral, without perispore, and numerous (upto 15,000) per sporangium. Prothallus tuberous and very small. Species 56, but only 1 in the area.

Ophioglossum nudicaule L. f.

The Adder's Tongue

(Plate I)

Syn.:– *Ophioglossum parvifolium* Hk. *et* Grev. and *O. reticulatum* L.

Axis a somewhat tuberous stock, small, about 10 mm. long and 3 mm. thick, erect, glabrous, and having very few succulent roots.

Fronds spirally arranged, usually few (often only 1, sometimes 2 or 3), succulent, stipitate and pinnate; pinnae dimorphous; vernation erect; stipe 15 mm. to 25 mm. long and more or less 1 mm. thick, and without any stipule-like outgrowth at the base.

Sterile pinnae simple, varying in form and size, evenly elliptical or lanceolate in exposed situations, generally 10 mm. to 20 mm. long and 3 mm. to 6 mm. broad, acute, cuneate, generally adnate to the base of the fertile stalk and appearing sessile, but stalked when without fertile pinna.

Fertile pinnae simple, linear, 3 mm. to 15 mm. long and 1 mm. to 2 mm. broad, rather acuminate, stalked, and forming an almost erect spike; stalk of fertile pinna terete, slender, generally 10 mm. to 20 mm. long from the point of attachment on the stipe.

Venation reticulate; costa indistinct; venules anastomosing and forming areolae with free included veinlets.

Sori unisporangiate, dorsal, arranged in two rows on the abaxial surface of the fertile pinna, forming a spike, and exindusiate; the spike having a sterile apex.

Sporangia uniseriate along each margin, originating from groups of cells, homosporous, large, globose, sunken in the spike, and stalked; sporangiophore short; sporangial wall of several layers of cells in thickness; annulus absent; dehiscence transverse, dividing the sporangium into 2 equal halves; spores numerous per sporangium, tetrahedral, and without perispore.

Prothallus tuberous, only a few mm. long, remaining underground, lacking in chlorophyll, and exhibiting mycorrhiza.

Small terrestrial herbs growing and merging with the grasses around lakes, swamps and other wet places of the plains.

Rich in protein-contents; eaten by horses and cattle while grazing; also said to be used elsewhere, for external applications for wounds, etc.

Subclass Marattiidae

The members of the Subclass Marattiidae are all terrestrial ferns. Their axes are thick, globose, generally unbranched and erect stocks, or very rarely creeping rhizomes, and sometimes dorsiventral. They have a siphonostele when young, which becomes later a complicated dictyostele with a ring or two of amphicribral vascular strands. They have also numerous mucilaginous canals. The fronds are large, unimorphous, and pinnate or digitate, with circinate vernation and succulent stipes which are articulate to the axis, and which have a

stipule-like outgrowth on either side, as well as mucilaginous canals and tannin cells inside, at the base. The pinnae are also articulate to the rachis, and their number varies in the bipinnate forms; but in the palmate or digitate forms, it is five. The venation is free in bipinnate fronds, but anastomosing in palmate or digitate fronds. The sporangia arise from groups of subepidermal cells, and have walls of several layers of cells in thickness, and form compact linear groups, or join sideways to form orbicular groups, on the dorsal surface. They are free, large, sessile and homosporous. They are all of the same age within the same group. They may sometimes fuse to form synangia. The annulus may be rudimentary or absent altogether. They dehisce longitudinally, liberating numerous tetrahedral or biplanate spores without perispore. The prothallus is monoecious, epigaeous, dorsiventral, cordate or linear, flat, green (containing chlorophyll), and shows mycorrhiza. The antheridia are sunk in the prothallial tissue.

This Subclass comprises only one order, viz., Marattiales.

ORDER MARATTIALES

Characters of this Order are the same as for the Subclass. Five families are included, but only one family, *viz.*, Angiopteridaceae, is represented here.

Family Angiopteridaceae

Members of the Family Angiopteridaceae have unimorphous fronds which may be pinnately or bipinnately divided. The venation is free. The sori are linear and exindusiate. But they are protected by scales which are fringed and which serve as pseudo-indusia. The sporangia are free, but closely arranged in two rows without fusing into synangia. An apical annulus is present, but it is only rudimentary. Three genera are included in this Family, but only one is recorded in the area.

GENUS **ANGIOPTERIS** HOFFM.
Vessel Ferns

Syn.:—*Clementea* Cav., and *Psilodochea* Pr.

Axis a succulent, almost globose, short and erect stock with radial symmetry and a complex vascular system, and covered with large succulent stipule-like outgrowths of older fronds. Fronds pinnate or bipinnate, without hard tissues but keeping themselves raised with the pressure of cell-sap, unimorphous and stipitate; vernation circinate; stipe articulate to the stock, succulent, green, clavate, and with a stipule-like outgrowth on each side at the base; pinnules narrow, oblong and stalked; pinnule-stalk swollen, and articulate to the rachis. Venation free, parallel, and generally with small recurrent veins between true veins. Sporangia free, but very closely arranged in linear or oblong or boat-shaped groups, 5 to 12 (sometimes upto 30) per group, obovate and sessile; sporangial groups in 2 opposite and contiguous but not coherent series, one on either side a vein, oblique to the midrib but near the margin, and exindusiate but protected by a pseudo-indusium of linear persistent scales; annulus apical and rudimentary; dehiscence longitudinal and towards the vein at the middle of the sporangial group; spores numerous (about 1440 per sporangium). Species about 100, but only 1 recorded in the area.

Angiopteris evecta (Forst.) Hoffm.
The Vessel Fern
(Plates II and III)

Syn.:— *Polypodium evectum* Forst., *Danaea evecta* Spr., and *Angiopteris crassipes* Wall.

Axis a somewhat erect stock, succulent, globose, upto 60 cm. long, with a complex vascular system, and covered with persistent stipule-like outgrowths of older fronds.

Fronds bipinnate, without hard tissues but rigid with pressure from cell-sap, unimorphous and stipitate; ambitus obtuse, widely varying in size, about 250 cm. long and 200 cm. broad;

venation circinate; stipes articulate to stock through a clavate base, about 100 cm. long, green, striated, downy, both hairy and scaly when young, and with a pair of succulent stipule-like outgrowths at the base; rachis green, narrowly alate at the apex, about 3 mm. thick, sparsely hairy and sparsely scaly; hairs and scales appressed and small; ultimate rachis branch 2 mm. thick and having a clavate base.

Pinnae 20 cm. to 50 cm. or more long; pinnules 2 cm. to 2·5 cm. apart, simple, oblong, widely varying in size, about 10 cm. long and 1·5 cm. broad, coriaceous, shining, glabrous, acuminate, serrate, generally dimidiate, sometimes cuneate, and stalked; pinna-stalk short, succulent, about 3 mm. long, and articulate to the ultimate rachis branch.

Venation simple or pinnate with a dark brown costa raised on both surfaces; costules furcate, free and parallel; vein-ends 1 in each tooth of the margin of the pinnule; sometimes recurrent veins running in between true veins from the margin but not much beyond the sporangial groups, and representing the probable lines of fusion of the divisions of the frond of some ancestral fern.

Sporangia originating from groups of cells above the vein-ends, homosporous, obovate, sessile, arranged in groups of 8 to 15 sporangia each; each group dorsal, linear or boat-shaped, oblique to costa, about 1 mm. inwards from the margin, consisting of sporangia of the same age, and exindusiate but protected by a pseudo-indusium of marginal, persistent and introse scales; sporangial wall of several layers of cells; annulus apical and rudimentary; dehiscence longitudinal and towards the middle of the sporangial group; spores numerous per sporangium, tetrahedral and without perispore.

Prothallus epigaeus, green, and showing mycorrhiza.

Handsome, terrestrial and gigantic-fronded fern; not collected in the area by the author; but reported to have been collected on the Kambakam Hills, however.

Graceful and ornamental, useful for gardens in low hill-stations, and helpful along with other vegetation in soil-binding on hill-slopes.

Subclass Filicidae

The members of the Subclass Filicidae are generally terrestrial, or epiphytic, or very rarely hydrophytic. Their axes may be short vertical stocks or underground rhizomes, creeping or ascending. The fronds show a multiplicity of forms and are aerial, keeping themselves up in the air either by their own strength or by climbing round supports. The vernation is circinate. The sori have homosporous sporangia, and may be indusiate or exindusiate; and in the former case the indusium may be fully developed or under-developed; and in the latter case the sori are generally protected when young by the margin which develops membranaceous outgrowths or which merely curves round for the purpose. The sporangium arises from a single superficial cell on the dorsal surface, possesses an annulus and a wall of one layer of cells in thickness, puts forth only a limited number of spores (generally a multiple of 4), and generally has a long and thin sporangiophore. It is homosporous. The spores are generally tetrahedral. The antheridia are raised above, but not sunk in, the prothallial tissue.

This Subclass comprises fourteen orders, of which only six are represented in the area, and they are Schizaeales, Pteridales, Dicksoniales, Gleicheniales, Blechnales and Polypodiales.

ORDER SCHIZAEALES

The characters of the Order Schizaeales are primitive and much varied. The ferns are terrestrial, epiphytic or scandent in habit. Their fronds are dichotomously or pinnately divided. The rachis is generally alate, the wing interconnecting the laminae of the adjacent

segments. The ultimate segments are simple, linear or oblong, short, obtuse, and sessile or almost so. They are entire generally, the proximal ones being sometimes crenate. Segments of the fertile fronds are lobed, the lobes being sorophores which may appear to be digitate or pinnate. The sorophores are either semiterete or narrowly foliose, and have each a costule. The venation is generally free. The costa is prominent and extends upto the apex, with simple or furcate costules proceeding from it. The sori are unisporangiate, exindusiate, and marginal when young, but taking up a dorsal position when old owing to the subsequent expansion of the lamina of the sorophore. The solitary sporangia are sessile and arranged in a single series on each side of the costule of the sorophore. The annulus may be apical or lateral and may have one to five rows of cells. There is also a distinct stomium. The spores may be biplanate or tetrahedral.

This Order comprises five families, four of which contain only extinct genera of the Carboniferous and Jurassic periods. Extant genera are found only in one family, viz., Schizaeaceae.

Family Schizaeaceae

Members of the Family Schizaeaceae are terrestrial and sometimes zerophytic, with creeping or erect axes which are covered with thick, simple, septate hairs or scales. The axis may be protostelic when creeping; or it may be solenostelic or dictyostelic when erect. It may have a dorsiventral or radial symmetry. The fronds are of diverse shapes and closely arranged on the rhizome. They may be erect or scandent. They may be dichotomously or pinnately divided, the fertile segments being considerably reduced in all the genera except one. In almost all cases the segments of fertile fronds develop sorophores at the vein-ends along the margin, or at the apices, or on special branches. Venation may be open, free and dichotomously branching, or sometimes reticulate. Each sorus consists of but one sporangium. The indusium is usually absent. The sporangia originate from the margins of sorophores, but soon become dorsal owing to subsequent lateral development of the sorophores. They are ovoid or pyriform in shape and large in size. They are generally sessile and have a complete and apical annulus with a distinct stomium, and their dehiscence is longitudinal and lateral (ie., along a line drawn from the apex to the base on only one side). Numerous spores are produced from each sporangium. They are pitted on the surface, do not have perispore, and may be tetrahedral or biplanate. The gametophyte is thalloid in most cases but filamentous in some. Four genera are included, but only one occurs in the area.

GENUS **LYGODIUM** SW.

Flexible Ferns

Syn.:- *Ugena* Cav., *Hydroglossum* Willd., *Odontopteris* Bernh., *Ripidium* Bernh., *Hugona* Cav. *ex* Roem., *Cteisium* Mchx., *Anthrolygodes* Pr.; *Ramondia* Mirb., *Lygodictyon* J. Sm., and *Vallifilix* Thouars.

Twining and scandent ferns, generally on moist earth, mostly evergreen but susceptible to prolonged drought. Axis a creeping rhizome, dorsiventral, dichotomously dividing, with a simple protostele, and copiously hairy at the apex. Apical hairs of the rhizome simple, multiseptate, stiff and pale but growing darker with age. Fronds arranged closely in 3 rows on a short rhizome or spaced out on a long rhizome, but all on one side on the rhizome, highly specialized, repeatedly and generally equally furcate, but sometimes unequally furcate so as to appear falsely pinnate, monopodial, unlimited in growth, upto a few metres long, erect when young but scandent when old, and stipitate. Stipes approximate or distant on the rhizome, with only one vascular strand at the base when young, slender, scandent, and without stipule-like outgrowths at the base. Rachis monopodially branching with unequal dichotomy, slender, scandent, and generally alate on the adaxial side. Primary branch of the rachis very short, generally alate on the adaxial side, producing a pair of secondary branches,

and terminating in a dormant apex. Dormant apex copiously hairy (hairs brown), becoming active and growing like the main rachis itself when immediately below an injury (to the main rachis). Secondary branches of the rachis bearing the segments, narrowly alate (except in one species) on the adaxial side, arising close to the dormant buds of the primary branches of the rachis, and having a raised and hairy adaxial side. Segments pinnately arranged or dichotomously branched, glabrous, somewhat stalked, and dimorphous. Sterile segments entire or dentate or lobate, with free, and once twice or thrice furcate veins proceeding laterally from the costa and sometimes anastomosing at the ends. Fertile segments only on the sides exposed to maximum sunlight, lobate with reduced lamina and pinnately-branched veins; fertile lobes narrow, serrate and specialized to bear the sori; stalk of pinnules alate on the adaxial side. Sorophores at the ends of most of the veins of the fertile lobes, serrate, and each having one main and a few lateral veins; lateral veins alternating and bearing a single sporangium each. Sporangia solitary, only one on a lateral vein, biseriate, originating near the margin but occupying later on a more superficial position owing to the subsequent extension of the surface of the fertile lobe, homosporous, oblong-ovoid or somewhat pyriform, large, stalked and indusiate. Indusium an outgrowth of the lamina, scariose, small and opening towards the vein-end. Sporangiophore short and lateral. Annulus transverse and complete. Dehiscence longitudinal. Spores varying in number, numerous per sporangium, pale, ornamented, tetrahedral and without perispore. Prothallus green and thalloid. Species 3, but only 1 in the area.

Lygodium scandens (L.) Sw.
The Fringed Snake's Tongue
(Plates IV, V and VI)

Syn. :- *Ophioglossum scandens* Linn., *O. filiforme* Roxb., *Lygodium salicifolium* Pr., *Ugena microphylla* Cav., *Lygodium scandens* var. *microphyllum* (Cav.) Luerss., *L. scandens* var. *intermedium* Ces., and *L. microphyllum* R. Br.

Axis a long creeping rhizome, dorsiventral, dichotomously branching, about 4 mm. thick, protostelic, and copiously hairy; hairs pale when young, brownish black when old, stiff spreading, and about 1 mm. long.

Fronds alternate, widely spaced on the rhizome, in 3 rows, pseudo-tripinnate, monostichous, of indefinite growth, stipitate; vernation circinate; juvenile fronds erect, once dichotomous, each branch bearing only 1 lamina; stipe slender, about 1·5 mm. thick, scandent, without stipule-like outgrowths at the base, sparsely hairy, alate, and with only one vascular strand at the base; rachis of indefinite growth, repeatedly and unequally furcate so as to appear falsely pinnate, slender, upto about 3 m. long, generally 1mm. to 1·5 mm. thick, scandent, glabrous distally and somewhat hairy proximally, but copiously covered with dark brown hairs at the dividing points; primary division of the rachis short, only about 2 mm. to 4 mm. long, producing a pair of secondary divisions, and ending in a pair of dormant and copiously hairy apex; dormant apex of the primary division of the rachis covered with dark brown hairs, becoming active and growing like the main rachis itself when immediately preceding an injured part on the main rachis; secondary division of the rachis arising close to the dormant apex of the primary division, pinnate, generally 3 cm. to 4 cm. long, bearing 3 to 4 segments on each side and ending in a terminal segment, narrowly alate, and with raised and minutely-hairy ventral surface.

Segments several, 7 to 9 per secondary branch of the rachis, alternate, pinnate, thin, pale green, ovate, glabrous, glaucous, caducous, truncate or cordate at the base, obtuse, dimorphous, articulate at the base, and stalked; stalk 2 mm. to 6 mm. long; juvenile segments oblong-obovate, 1·5 cm. to 2·5 cm. long, 5 mm. to 8 mm. broad, quadrilobate, crenate, obtuse and not articulate at the base.

Sterile segments ovate, about 2·5 cm. long, upto 14 mm. broad, obtuse, and crenate or undulate or lobate; fertile segments generally on the side of maximum sunlight, subdeltoid, about 2·5 cm. long, about 15 mm. broad, obtuse, truncate, and having sorophores; sorophores narrow, about 5 mm. long, each with 1 main vein and a few lateral alternating veins and with sporangia at the ends of most of the lateral veins.

Venation free; the veins branching off pinnately from a somewhat distinct costa, once twice or thrice furcate, and somewhat recurrent.

Sori unisporangiate, cone-like, closely arranged in 2 rows on ends of lateral veins (only one sporangium per vein-end) of fertile lobes, and exindusiate but protected by a 2-lipped pseudo-indusium, the lower lip being the scariose, ovate, bractiform, cucullate, pocket-shaped, and persistent scale-like structure which opens forwards (towards the apex of the fertile lobe), and the upper lip being the expansion of the lamina.

Sporangium solitary, originating from a single superficial cell near the margin but subsequently taking a more dorsal position because of subsequent expansion (as the upper lip of the pseudo-indusia) of the lamina, homosporous, oblong-ovoid, large, and stalked; sporangiophore short and lateral; sporangial wall of a single layer of cells; annulus apical, complete, and with a stomium; dehiscence longitudinal, lateral and away from the margin; spores numerous per sporangium, pale, pitted, tetrahedral, and without perispore.

Prothallus with antheridia raised over, and therefore appearing to hang down from, the surface of the prothallial tissue.

Beautiful, terrestrial and scandent fern of scrub jungles, etc. in the plains, and of the wooded places at the foot of the hills; growing as weeds on the banks of ponds and swamps which are affected by seasonal drought; or climbing up trees, shrubs and other supports with the help of rachises and their branches; or sometimes lying prostrate.

Economic application not observed in the area; but rachis and its branches reported from other places as useful for cordage and plaiting; juvenile fronds said to be edible and adult ones medicinal as expectorant and as external application for carbuncles, sprains, wounds, etc.

ORDER PTERIDALES

This is a very large order, and in fact, the largest among the known orders of extant ferns, comprising about ten families. Its characters therefore vary as widely, and only a free general and flexible description can be given. Most of the plants are terrestrial, xerophytic or lythophytic, while some of them are epiphytic; they have an exception however in **Ceratopteris** Brongn. which is hydrophytic. Most of them, with a few exceptions, are also perennial. The axis may be a creeping or scandent rhizome, or an erect stock. The stele, too, may vary from protostele in some ferns, and solenostele in some others, to dictyostele in yet others. The fronds may be unimorphous or subdimorphous, and simple or variously divided, and generally not articulate to the axis. The sori are mixed, dorsal, and either confined to the vein-ends, or confluent at the vein-ends, or extending as coenosori along vascular commissures connecting the vein-ends, or spreading along the veins in an acrostichoid manner. With very few exceptions, they all lack in indusia. The role of the indusium is played by the margin curling over the sori, or by the reflexed marginal lobes, or by paraphyses. In certain cases the sori are also arranged in grooves. The sporangia are generally stalked; the sporangiophore consists of one cell at the base but several cells near the sporangium. The annulus is longitudinal and incomplete, and dehisces transversely. The spores are tetrahedral or biplanate and have no perispore. The gametophyte of all these ferns, is flat, cordate, and chlorophyllous. About ten families are included, but only five of them, viz., Actiniopteridaceae, Sinopteridaceae, Gymnogrammaceae, Adiantaceae and Vittariaceae are represented in the area.

Family Actiniopteridaceae

Members of the Family Actiniopteridaceae are terrestrial ferns, the axes of which are short, subglobose and somewhat erect. Their axes have radial symmetry and perforated solenostele. They are also copiously covered with persistent stipe-bases and scales. These scales are brown when young, but grow darker with age. The fronds are long-stalked, spirally clustered on the axis, and simple but tripartite almost to the base, each segment being once or more times dichotomously digitate. The stipes are not articulate to the stock. The lobes radiate and accord a fan-shaped appearance to the ambitus of the frond as a whole. They are linear, rachiform, coriaceous, glabrous and furcate. The lobes are also subdimorphous, the sterile ones being shorter than the fertile ones. The venation is free; but the vein-ends, in the case of fertile fronds, are connected by longitudinal vascular commissures. The veins are few and almost parallel, and run the whole length of the lobe starting from an indistinct costa. The sori are mixed, linear, submarginal coenosori on the vascular commissures. They have neither indusium nor paraphysis; but the reflexed margins serve to protect them when young. The sporangia are long-stalked, each sporangiophore consisting of three vertical rows of cells. The spores are tetrahedral and smooth or somewhat so, and have no perispore. This is a monogeneric family.

GENUS ACTINIOPTERIS LINK

Ray Ferns

Syn.:- *Asplenium* L.

Characters of this Genus are the same as for the Family. Species 5 but only 1 in the area.

Actiniopteris radiata (Sw.) Link

The Ray Fern

(Plate VII)

Syn.:- *Acrostichum radiatum* Koen., *A. australe* Vahl, *A. dichotomum* Forsk., *Acropteris radiata* Fee, *Asplenium radiatum* Sw., *Blechnum flabellatum* Pr., *B. radiatum* Pr., *Pteris radiata* Mett., *Actiniopteris dichotoma* Bedd., and *A. australis* L. f.

Axis an almost erect stock, subglobose, short, about 2 mm. thick, with radial symmetry and perforated solenostele, copiously covered by persistent stipe-bases, and copiously scaly; scales brownish, lanceolate and flat.

Fronds spirally clustered, and dichotomously tripartite, subdimorphous (sterile fronds shorter than fertile ones), and stipitate; vernation circinate; ambitus resembling the leaves of a miniature palmyrah palm, about 2·5 cm. to 3 cm. in radius, obtuse, incissed along the margin and truncate at the base; stipe 5 mm. to 70 mm. or more long, shorter in sterile fronds and longer in fertile ones, 0·5 mm. thick, persistent, not articulate to the axis, without stipule-like outgrowths at the base, and scaly; the scales on the stipe brownish, lanceolate, and about 2 mm. long; rachis indistinct.

Segments numerous, radiating and according the characteristic fan-shaped appearance to the frond, without stipule-like outgrowths at the base, digitate, linear, rachiform, very narrow, coriaceous, mucronate, with bifid apices, and glabrous.

Venation free; costa indistinct; veins few, almost parallel; vein-ends interconnected by vascular commissures in the case of fertile fronds.

Sori multisporangiate, mixed, submarginal, linear, dorsal, parallel to costae and continuous as coenosori along the vascular commissures, and exindusiate but protected by the reflexed margin of the lobe.

Sporangia originating from single superficial cells, homosporous, and stalked; sporangiophores long, and consisting of 3 vertical rows of cells; the sporangial wall of a single layer of cells in thickness; annulus longitudinal and incomplete; dehiscence transverse; spores tetrahedral, smooth or almost so, and without perispore.

Small terrestrial fern of the dry areas; curiously shaped like a miniature palmyrah palm; capable of tiding over severe drought; on Vandalur, Pallavaram, Kambakam and other Hills, but now getting scarcer in its former habitations; growing also as weeds on the walls and tiles of old constructions which have not been renovated for decades and which are about 16 km. away from the coast.

Useful as styptic and anthelmintic in medicinal preparations, and as an ornament in the vase in the drawing-room.

Family Sinopteridaceae

Members of the Family Sinopteridaceae are all terrestrial and mostly xerophytic. The axis is generally scaly and solenostelic. It may be a creeping rhizome or an erect stock. The scales are castaneous and somewhat lanceolate. The fronds are generally glabrous but sometimes slightly hairy or farinose with white or yellow farina on the abaxial surface. They are stipitate and generally unimorphous, and divide pinnately but in varying degrees. The ambitus of the frond varies from linear to deltoid in shape. The stipes are terete, castaneous, shining and not articulate to the rhizome. The veins are free. The sori are dorsal, mixed, and borne on the distal parts of the veins. They are unisporangiate in some cases. They are orbicular, but slowly become confluent and extend along the veins a short distance towards the costa. They are exindusiate; but they are protected when young, by the membranaceous, veinless, reflexed, continuous or interrupted, marginal lobes of the frond. The sporangia are globose-pyriform, large and almost sessile or short-stalked. In some species they are solitary on the vein-ends. The spores are large, globose-tetrahedral, and warty or spiny; or sometimes distinctly tetrahedral and smooth. They have no perispore. The Family contains about a dozen genera, but its classification still needs confirmation. It is represented in the area, only by one genus.

GENUS CHEILANTHES SW.

Lip Ferns

Syn.:—*Gymnia* Haml., *Allosorus* Bernh., *Othonoloma* Link, *Cassebeera* J.Sm., *Physapteris* Pr., *Notholaena* R.Br., *Myriopteris* Fee. *Aleuropteris* Fee, and *Adiantopsis* Fee.

Terrestrial, small, and generally xerophytic, but not confined to dry places. Axis almost an erect stock, very short, solenostelic, copiously scaly, and sometimes hairy as well; steles 1 to 3, exarch when only one, and endarch when more than one; scales linear, entire, and not peltate at the base. Fronds clustered, bipinnatifid to tripinnate, very rarely simple, small, generally under 30 cm. long, hairy or scaly, rarely glabrous, stipitate; ambitus linear to broadly deltoid; stipes not articulate to the stock, generally castaneous or ebenous, shining, slender, containing a single vascular strand at the base, and sparsely hairy when young; meristeles 1 to 3, exarch when only one and endarch when more than one; rachis black, shining. slender, distally alate, grooved on the ventral surface, and somewhat hairy when young. Basal pinnae generally enlarged on the basiscopic side. Ultimate segments broadly orbicular, very small, subcoriaceous, sometimes hairy or scaly, sometimes granulose with white or yellow farina on the dorsal surface, and dentate; marginal tooth membranaceous, irregularly shaped and reflexed. Venation free and veins thickened at the ends. Sori terminal on the vein-ends, having punctiform receptacles, mixed, somewhat orbicular and solitary but generally confluent laterally and extending towards the costa but not on the reflexed lobes, and sometimes confluent along the margin (but not continuously), and exindusiate but generally protected somewhat by the reflexed lobes of the margin when young; reflexed lobes veinless, either broadly orbicular and distinct or oblong and interrupted, introse, and sometimes under-developed or wanting.

Sporangia few per sorus, and stalked; sporangiophore long at maturity; annulus longitudinal and incomplete; dehiscence transverse; spores 24 to 64 per sporangium, globose-tetrahedral, generally smooth, sometimes granular or corrugated, and without perispore. Species more than 100, all needing a thorough revision; but only 3 in the area.

Cheilanthes mysurensis Wall.

The Mysore Lip Fern

(Plates VIII and IX)

Syn.:- *Cheilanthes fragrans* Sw., *C. swartzii* Webb *et* Bert., *C. opposita* Klf., and *Asplenium mysorense* Heyn.

Axis an almost erect stock, slender, indistinct, very short, less than 2 mm. thick, solenostelic and copiously scaly; scales dark brown, lanceolate, 1 mm. to 2 mm. long, entire, and not peltate at the base; roots profuse, caespitose, fibrous and woolly.

Fronds clustered, bipinnate, unimorphous and stipitate; ambitus linear-oblong, tapering down towards the base by the diminishing size and number of the proximal pinnae, about 6 cm. to 15 cm. long, about 3 cm. broad at the widest, and acute; vernation circinate; stipes not articulate to the stock, short, about 1 cm. to 2·5 cm. long, thin, 1 mm. thick, wiry, terete, flexuose, often persistent on the stock, black, ebenous, shining, having a single vascular strand at the base, and hairy when young; hairs on stipes multicellular, dark brown, 1 mm. to 2 mm. long; rachis pinnate, 5 cm. to 14 cm. long, 1 mm. thick, often persistent, black, slender, ebenous, shining, alate, distally grooved on the ventral surface, hairy proximally and sparsely so distally; hairs on rachis dark brown, linear, 1 mm. to 2 mm. long; rachis branch articulate to the main rachis, less than 0·5 mm. thick, black, ebenous, shining, alate distally, and almost glabrous.

Pinnae sessile; distal pinnae alternate and pinnatifid, and the others opposite and pinnate; ambitus of pinnae oblong-ovate, about 1 cm. long, upto 5 mm. broad, obtuse, somewhat decurrent at the base, and not farinose on the dorsal surface.

Pinnules upto 11 per pinna, alternate except the most basiscopic pair (which are opposite), simple, oblong, about 4 mm. long, about 2 mm. broad, much incurved when dry, subcoriaceous, glabrous, obtuse, pinnatifid, crisped along the margin, decurrent at the base, not farinose or he dorsal surface, and sessile; marginal teeth membranaceous and reflexed.

Venation free, dividing anadromically; costa dark, ebenous, and partly shining; vein-ends thickened.

Sori multisporangiate, superficial, mixed, somewhat orbicular on punctiform receptacles on thickened vein-ends near the margin, one or two on each segment of the pinnule (but none on the marginal lobe of the segment), sometimes becoming somewhat confluent and oblong and discontinuous, and exindusiate but protected by a marginal lobe when young; marginal lobe veinless, reflexed, membranaceous, orbicular or oblong like the sorus, somewhat persistent but losing identity, not continuous but interrupted, and introse.

Sporangia multiseriate, few per sorus, originating from single superficial cells, homosporous, globose-pyriform and stalked; sporangiophore generally short but long at maturity, and single-celled at the base but many-celled near the sporangium; sporangial wall of a single layer of cells; annulus longitudinal and incomplete; dehiscence transverse; spores globose-tetrahedral, warty, and without perispore.

Prothallus flat, cordate and chlorophyllous.

Terrestrial, xerophytic, small and perennial; common in dry rocky places on and near the hill-slopes; the pinnules curling up and resisting drought.

Useful in combination with parts of other plants for the vase in the drawing-room, and for making button-holes, etc.

Cheilanthes tenuifolia (Burm.) Sw.

The Slender-leaved Lip Fern

(Plate X)

Syn.:- *Trichomanes tenuifolia* Burm., *Cheilanthes micrantha* Wall., *C. moluccana* Kze., *C. rupestris* Wall., *C. sieberi* Lowe, *C. hispidula* Kze., *Acrostichum tenue* Retz., *Adiantum cicutaefolium* Lamk., *A. tenuifolium* Sw., *A. varians* Poir., *Cassebeera tenuifolia* J. Sm., *Dryopteris campestris* Rumph., *Pteris humilis* Forst., *P. nigra* Retz., and *Aspidium tenue* Retz.

Axis an almost erect stock, short, solenostelic and scaly; scales green when young, becoming brown with age, linear, entire, and not peltate at the base.

Fronds clustered, tripinnate or subtripinnate, subdimorphous and stipitate; ambitus ovate or somewhat deltoid-lanceolate, about 10 cm. long and 6 cm. broad when sterile but upto 30 cm. long and 10 cm. broad when fertile, acute or acuminate, and hairy (when sterile); hairs on the sterile frond stiff, scattered and branched; vernation circinate; stipes not articulate to the stock, about 5 cm. long for sterile fronds and about 25 cm. long for fertile fronds, terete, wiry, flexuose, purple black or dark brown, slender, shining, grooved distally on the ventral surface, having only a single vascular strand at the base, and hairy when young; rachis sparsely hairy, alate distally; primary and secondary rachis-branches alate narrowly; wings narrow and bordering the edges of the grooves; hairs on the rachis dark brown and persistent in the groove.

Pinnae numerous, alternate, pinnate, dimorphous, not granulose on the dorsal surface, and stalked; ambitus deltoid, oblique and acute; sterile pinnae approximate, those at the bottom being about 6 cm. long and about 3·5 cm. broad; fertile pinnae widely-spaced, those at the bottom being generally about 10 cm. long and 5 cm. broad.

Pinnules alternate, either pinnate or deeply pinnatifid, dimorphous, herbaceous, obtuse and stalked; ambitus oblong; those on the basiscopic side of the pinna bigger and longer than those on the acroscopic side; pinnules at the base of the frond largest, about 2 cm. long, subcoriaceous; sterile pinnules sparsely hairy on the ventral surface, nearly glabrous on the dorsal surface, and not farinose.

Segments alternate, oblong-lanceolate, acute, entire or lobate, and soriferous in fertile fronds; lowest segments largest, and upto about 5 mm. long and about 2 mm. broad; ultimate segments of pinnules largest, obtuse and broadly dentate.

Venation free, once or twice furcate, and indistinct in sterile fronds; vein-ends thickened.

Sori multisporangiate, mixed, superficial but close to the margin, on punctiform receptacles, terminal on veins, orbicular, sometimes eventually becoming confluent along a submarginal line, but none on the reflexed lobes of the margin, and exindusiate but protected when young by the reflexed marginal lobe; reflexed marginal lobe membranaceous, veinless, brownish, somewhat orbicular and distinct, mostly elongate, interrupted, narrow, and introse.

Sporangia multiseriate, few per sorus, originating from single superficial cells, homosporous, globose-pyriform and stalked; sporangiophore single-celled at the base but many-celled near the sporangium, generally short, but long at maturity; sporangial wall of a single layer of cells; annulus longitudinal and incomplete; dehiscence transverse; spores large, almost black, globose-tetrahedral, warty and without perispore.

Prothallus flat, cordate and chlorophyllous.

Terrestrial, pretty, small and perennial xerophyte; common in dry localities in the plains and on the hill-slopes; the pinnules curling up and resisting drought.

Preparation from the roots prescribed by some in cases of sickness from witch-craft; useful in combination with parts of other plants, for the vase in the drawing-room, for the button-holes, etc.

Cheilanthes farinosa (Forsk.) Klf.

The Silver Fern

(Plate XI)

Syn.:–*Pteris farinosa* Forsk., *P. decussiva* Forsk., *P. argentea* Bory., *P. argyrophylla* Sw., *P. bicolor* Roxb., *P. sulphurea* Cav., *Cheilanthes chrysophylla* Hk., *C. bulbosa* Kze., *C. argentea* var. *chrysophylla* Hk., *C. dealbata* Wall., *C. rigidula* Wall., *C. pulveracea* Spr., *C. candida* Hassk., *Aleuritopteris argyrophylla* Fee, *A. dealbata* Fee, *A. farinosa* Fee, *A. sulphurea* Fee, *A. mexicana* Fee, *Allosorus argyrophyllus* Pr., *A. farinosus* Pr., *A. sulphureus* Pr., *A. pulveraceous* Pr., *A. dealbatus* Pr., *Cassebeera farinosa* J. Sm., *Notholaena sulphurea* J. Sm., and *Cheilanthes farinosa* Spr.

Axis an erect stock, slender, short, solenostelic and copiouly scaly; scales dark brown, linear-lanceolate, entire, and not peltate at the base; roots making a dense cluster.

Fronds clustered, erect, bipinnate at the base and bipinnatifid at the apex, unimorphous and stipitate; ambitus deltoid-lanceolate, about 15 cm. long, about 6 cm. broad at the widest, acuminate and cordate; vernation circinate; stipe not articulate to the stock, upto 10 cm. long or as long as the ambitus of the frond, slender, about 2 mm. thick, terete, purplish, shining, without stipule-like outgrowths at the base, and glabrous (but hairy when young); rachis slender, about 2 mm. thick, terete, purplish, shining, distally alate, grooved lightly on the ventral surface below the distal pinnae, and glabrous (but hairy when young); hairs on the stipes and rachises multicellular.

Pinnae opposite, spaced out, membranaceous, stiff and glabrous; distal pinnae pinnatifid, linear-deltoid and sessile; lobes of the distal pinnae broadly obtuse when sterile and narrow when fertile; the basal basiscopic lobe the largest; proximal pinnae pinnate, free from the succeeding pinnae, and stalked; ambitus of the proximal pinnae lanceolate, that of the bottom-most being half-deltoid, about 4 cm. long, about 3 cm. broad at the base, and acuminate; the stalk of proximal pinnae short.

Pinnules adnate, basal pinnules of the proximal pinnae alone being free; basiscopic pinnules of the lowest proximal pinnae enlarged, upto about 2 cm. long, and lobate.

Segments generally alternate, linear-lanceolate, upto 5 mm. long, 2 mm. or more broad, subcoriaceous, glabrous ventrally, farinose near the costules on the abaxial surface, acute, having reflexed margins; and the proximal segments of the proximal pinnae being deeply lobate again and longer than the others; segments of the distal pinnae being confluent at the base and forming wings for rachis-branch; farina very small, like waxy powder, and white but turning yellow with age; lobes minute, and entire or undulate.

Venation free, and furcate; costa and costule ebenous, shining and glabrous; vein-ends thickened.

Sori multisporangiate, mixed, dorsal, somewhat orbicular on punctiform receptacles, terminal on thickened vein-ends near the margin, sometimes somewhat confluent and oblong but not continuously so, absent on the reflexed marginal lobe, and exindusiate but protected by the reflexed marginal lobe when young; reflexed marginal lobe scariose, membranaceous, veinless, distinct and broadly orbicular, sometimes confluent and interrupted or dentate, brown and introse.

Sporangia few per sorus, originating from single superficial cells, very large, homosporous, globose-pyriform and stalked; sporangiophore single-celled at the base but many-celled near the sporangium, generally very short, but long at maturity; sporangial wall of a single layer of cells; annulus longitudinal and incomplete; dehiscence transverse; spores globose-tetrahedral, large, warty and without perispore.

Prothallus flat, cordate and chlorophyllous.

Terrestrial, small, perennial and xerophytic fern of dry rocky places near hill-slopes; not collected in the area by the writer; but reported to have been collected on the Kambakam Hills, however.

Ornamental, and often cultivated in parks and gardens.

Family Gymnogrammaceae

Members of the Family Gymnogrammaceae are terrestrial and generally xerophytic and perennial. They vary widely in form and size. The axis may be an erect stock or a creeping rhizome, and has generally a solenostele. The frond may be simple or variously pinnate; and when simple it may be lanceolate, ovate or cordate, and entire or palmately lobate. It is generally unimorphous but sometimes dimorphous. It is membranaceous in texture and hairy in varying degrees, the hairs being non-articulate. The veins are generally free, but sometimes they are united either only near the margin to form one or more series of areoalae, or all over the lamina to become reticulate. The sori may be linear, or they may consist of only scattered and superficial sporangia which follow the course of the fertile veins on the dorsal surface. They may be mixed, paraphysate or non-paraphysate, but they have no indusium; they are generally protected by the modified margin. The sporangia are large-sized but short-stalked, and have longitudinal and incomplete annulus. They dehisce transversely, liberating generally a few (32 or 64) spores. A number of genera are included in this Family, but only 1 represents it in the area.

GENUS **HEMIONITIS** L.

Mule Ferns

Syn.:—*Gymnogrammitis* Link.

Terrestrial. Axis an almost erect stock, short, dictyostelic, and scaly; scales brown to black, thin, sometimes narrowing into hairs, the broader ones developing ribs, and never peltate. Fronds clustered on the rhizome, simple, entire or palmately lobate, stiff, hairy or somewhat scaly on the dorsal surface, cordate to hastate, somewhat dimorphous and stipitate; scales on the fronds passing slowly into septate hairs; stipes not articulate to the rhizome, shorter for sterile fronds than for fertile ones, and brownish to black. Venation reticulate with areolae; areolae elongate, unequal, and hexagonal without free included veinlets Sori dorsal, spreading along the veins and becoming acrostichoid-like, and exindusiate but having scales and hairs. Sporangia homosporous and stalked; sporangiophore short; spores tetrahedral, with small spines, but without perispore Species 8, but only 1 in the area.

Hemionitis arifolia (Burm.) Moore

The Aerial-leaved Mule Fern

(Plate XII)

Syn.:—*Asplenium arifolium* Burm., *Hemionitis cordata* Roxb.

Axis an almost erect stock, short, about 2 mm. thick, dictyostelic, copiously scaly at the apex; scales concolorous, light brown, linear-lanceolate, entire, narrow, and not peltate at the base.

Fronds spirally-clustered on the stock, simple, coriaceous, stiff, glabrous and dark green on the adaxial surface, villous and pale green on the abaxial surface, obtuse, entire, auriculate, dimorphous, and stipitate; venation circinate; scales on the fronds passing slowly into hairs; hairs light brown and septate; stipes not articulate to the stock, erect, about 4 cm. to 9 cm. long for sterile fronds, about 20 cm. to 25 cm. long for fertile fronds, almost black, shining, grooved adaxially, without stipule-like outgrowths at the base, scaly at the base but somewhat copiously both hairy and scaly at other parts; scales and hairs on the stipes brown; hairs lax, spreading, multiseptate, and about 2·5 mm. long.

Lamina of sterile frond narrowly ovato-cordate, about 6 cm. long, about 4 cm. broad, coriaceous, obtuse, cordate at the base, with a long sinus separating the obtuse basal auricles, and dorsally both hairy and scaly; both scales and hairs brown; hairs spreading, lax, multiseptate, and about 1 mm. long.

Lamina of fertile frond trifoliately and shallowly lobate, and both hairy and scaly dorsally; ambitus sagitate, appearing to be somewhat triangular, upto 8 cm. long, upto 5 cm. broad along the lateral lobes, both narrow and obtuse at the apex, and truncate at the base; basal auricles somewhat triangular, sagitate, about 3 cm. long, about 1·5 cm. broad, and obtuse; scales long, lax, and narrow.

Venation reticulate; costa dark, raised, and slightly hairy and scaly; the veins anastomosing and forming areolae; areolae numerous, oblique-elongate, without included veinlets, and hidden in the case of sterile fronds.

Sori unisporangiate, mixed, dorsal, soon becoming continuous and somewhat linear on the reticulate veins, and there-by pseudo-acrostichoid, and exindusiate but having numerous long narrow scales and hairs.

Sporangia numerous, scattered on the veins but soon becoming confluent, originating from single superficial cells, homosporous, subglobose, large, and stalked; sporangiophore short; sporangial wall of a single layer of cells; annulus longitudinal and incomplete; dehiscence transverse; spores tetrahedral, large, with spines, and without perispore.

Small, common, variable, herbaceous and terrestrial fern of dry localities of the plains and low elevations.

Ornamental for use in the vase in the drawing-room.

Family Adiantaceae

Members of the Family Adiantaceae may be perennials or annuals of generally small to moderate size and of diverse habit. Some of these plants belong to dry situations and some others to moist and shady situations. The axis may be long and creeping, or short and erect. It has generally a simple solenostele which sometimes presents too many leaf-gaps, and thus appears to be composed of a number of meristeles. It has a covering of scales which are not peltate at the base, and which may be narrow and dark, or fringed with paler cells. These paler cells are serrate or hairy when young. The fronds are generally clustered spirally on the axis. They are stipitate, unimorphous or somewhat subdimorphous, and once to thrice pinnate, or sometimes somewhat dichotomously divided. They are rarely entire. They remain always so dry that they cannot be easily rendered wet. Only the distal parts of the fronds are fertile. The stipe has only two vascular strands at the base, and is not articulate to the axis. Both the stipe and the rachis are brittle, dark, ebenous, shining, and sometimes somewhat hairy. The rachis is grooved on the adaxial surface, and roots at the apex when it (the apex) comes in contact with the soil. The lamina of the ultimate segment is unilateral, or fan-like to parallelogram-like, about 11 mm. to 18 mm. long, 5 mm. broad, cuneate, and almost sessile. The margin is dentate when the frond is sterile, but lobate or somewhat entire when it is fertile. The texture is herbaceous or (very rarely) coriaceous. The lamina is generally glabrous, but sometimes hairy or (very rarely) glaucous. The hairs on the lamina are multicellular, black and shining. The lobes of the fertile fronds are brown, membranaceous, soriferous and strongly reflexed to protect the sporangia till they (sporangia) attain maturity. The venation is generally free, and has no main veins. The venules fork dichotomously from the base and are generally free. They are always parallel when running in the fertile lobes. The sori are of a mixed kind and contain sporangia of all ages. They are dorsal generally on the veins on the dorsal surface of the marginal lobes. They may be small, orbicular and confined to the vein-ends, or linear and spreading along the veins for shorter or longer distances from the margin. They rarely occur between the veins. They are exindusiate but protected when young by the reflexed lobes of the lamina. The sporangia are pyriform, homosporous and large with sporangiophores of three rows of cells, and with longitudinal annuli which are incomplete. They dehisce transversely. The spores are generally large and few (ranging from 12 to 72) per sporangium, tetrahedral, dark, and smooth without perispore. This is a monogeneric family.

GENUS ADIANTUM L.

Maidenhair Ferns

Syn. :—*Adiantellum* Pr., *Apotomia* Fee, *Synechia* Fee, *Mesopleuria* Moore, and *Hewardia* J. Sm.

Characters of this Genus are the same as for the Family. Species about 200, but only 1 in the area.

Adiantum caudatum L.

The Walking Fern

(Plate XIII)

Syn.:—*Adiantum hirsutum* Bory., *A. vestitum* Wall., *A. proliferum* Roxb., *A. ciliatum* Bl., *A. flagelliferum* Wall., *A. incisum* Forsk., *A. caudatum fissum* Fee, and *A. capillus* Webb.

Axis an almost erect stock, short, about 1·5 mm. thick, solenostelic, and copiously scaly; scales concolorous, dark brown, with paler cells at the edges, lanceolate, narrow, 4 mm. to 5 mm. long, and not peltate at the base; paler cells dentate or hairy when young.

Fronds spirally clustered on the stock, pinnate, almost unimorphous, and stipitate; vernation circinate; ambitus oblong-linear, 13 cm. to about 30 cm. long, and 2·5 cm. to 3 cm. broad; stipes not articulate to the stock, about 3·5 cm. to about 10 cm. long, about 1 mm. thick, wiry, brittle, with 2 vascular strands at the base, purple to black, ebenous, shining, scaly proximally and hairy distally, and without stipule-like outgrowths at the base; rachises varying in length, slender, brittle, purple to black, ebenous, grooved along the adaxial surface, with a shining abaxial surface, and hairy; apex of the rachis sometimes not bearing pinnae but elongating and rooting when in contact with the soil and producing another plant vegetatively; hairs on the stipes and rachises dark brown, multicellular, thin, small, stiff and spreading.

Pinnae many, alternate, more approximate at the apex than at the base, simple, lobate with narrow sinuses extending down to about ½ width of the lamina from the acroscopic margin, straight and entire along the basiscopic margin, unilateral and almost parallelogram-like, 10 mm. to 15 mm. long, about 5 mm. broad, thin, stiff, coriaceous, hairy, cuneate, subsessile, strongly resistent to water, characteristically curling down in dry weather, and sometimes deciduous; the basiscopic and basal margins of each pinna straight; the former (basiscopic margin) almost perpendicular to the rachis; the acroscopic and apical margins of each pinna deeply lobate, the apical margin short and broadly obtuse; lobes 4 or 5, generally again lobate, brown, about 3 mm. long, membranaceous, crisped, somewhat dentate in sterile pinnae, and rolling outwards and downwards along the dorsal surface; pinna-stalk about 0·5 mm. long.

Venation free, and lacking in separate costa; the venules generally raised on the adaxial surface, dichotomously and anadromically dividing and radiating from the base, free, and extending into the marginal lobes as parallel veins.

Sori multisporangiate, mixed, dorsal though apparently marginal, small and orbicular or a little elongate, on 2 or more veins on the dorsal surface of the apices of the fertile lobes, and exindusiate but protected by the sharply-reflexed fertile lobes.

Sporangia multiseriate, originating from single superficial cells, homosporous, pyriform, and stalked; sporangiophore short, and consisting of 3 rows of cells; sporangial wall of a single layer of cells; annulus longitudinal and incomplete; dehiscence transverse; spores black, tetrahedral, large, smooth and without perispore.

Small, terrestrial, and xerophytic fern of the dry areas in the plains and lower elevations like the Hills of Vandalur, Kambakam, etc.

Fronds in combination with leaves of other plants, useful in making button-holes, bouquets, etc.; also medicinal in the treatment of skin-diseases, diabetes, cough and fever.

Family Vittariaceae

Members of the Family Vittariaceae are small and epiphytic with a creeping axis which may be either protostelic, or dorsiventral and dictyostelic with a ring of vascular strands, and which may have a covering of clathrate scales. The sclerenchyma is absent. The fronds are generally closely arranged on the rhizome but not articulate to it. They are unimorphous and generally simple, but sometimes furcate. The venation is free in those forms which have protostelic rhizomes, but reticulate in the others. The epidermis of the frond includes spicular cells. The sori are of a mixed kind and contain sporangia of all ages. They are dorsal and linear as coenosori along the veins, often sunken in a groove, and exindusiate; but they are protected when young by the clavate or filiform paraphyses. The sporangium has a distinct sporangiophore and a longitudinal annulus, and dehisces transversely. The sporangiophore is many-celled distally but only single-celled at the base. The spores are few in number, triplanate and devoid of perispore. This Family includes seven genera whose placements are yet to be confirmed. It is represented in the area by only one genus, however.

GENUS **VITTARIA** SM.

Grass Ferns

Syn.:- *Runcinaria* Mull., *Aristaria* Mull., *Parenchymaria* Mull., *Haplopteris* Pr., *Taeniopsis* J. Sm., and *Taeniopteris* Hk.

Generally epiphytic. Axis a creeping rhizome, slender, dorsiventral, dictyostelic, occasionally furcate, scaly, and copiously covered with roots; internodes about 10 mm. long; scales on the rhizome black, generally iridescent, oblong, attenuate, and clathrate. Roots hairy, and absorbing and retaining water; hairs on the roots brown. Fronds alternate, simple, linear-elongate, pendulous, upto 1 m. long, more than 1·5 mm. broad, coriaceous, glabrous, entire, containing spicular cells in the epidermis, and sessile or stipitate; spicular cells linear and submarginal; margin strongly reflexed to meet its opposite number in periods of drought; stipe (when present) short, alate and containing 2 vascular strands at the base. Venation reticulate; costa evanescent; lateral veins oblique, generally simple but sometimes furcate, anastomosing along a continuous submarginal line, and forming areolae; areolae without free included veinlets, either small and numerous or large and generally uniseriate on each side of the costa. Sori mixed, confluent as linear coenosori on a receptacle formed by the submarginal vein, almost superficial or sunken in a submarginal groove on the dorsal surface, exindusiate and paraphysate. Paraphyses hair-like, brown, branched, and having obovoid cells at the apex. Sporangia few per sorus and stalked; sporangiophore one-celled at the base but many-celled at the apex; annulus longitudinal; spores 64 per sporangium, pale, hyaline, biplanate and smooth. Species doubtfully 80, and needing revision; but only 1 in the area.

Vittaria elongata Sw.

The Elongated Grass Fern

(Plate XIV)

Axis a long creeping rhizome, occasionally dividing, slender, about 2 mm. thick, dorsiventral, dictyostelic, without sclerenchyma, copiously scaly, and copiously covered with roots; scales on the rhizome almost black, oblong, hair-like, attenuate, clathrate, about 5 mm. long, and entire; roots copiously hairy, absorbing and retaining water; hairs on the roots brownish yellow.

Fronds uniseriate, at intervals of about 5 mm. to 7 mm. (on the rhizome), simple or furcate, linear-elongate, pendulous, over 50 cm. long, 4 mm. to 6 mm. broad, coriaceous, grooved longitudinally near the margin, glabrous, containing spicular cells in the epidermis, acuminate, entire, decurrent, unimorphous and stipitate; vernation circinate; spicular cells elongate and submarginal; margin strongly reflexed to meet its opposite number in periods of

drought; stipe not articulate to the rhizome, short, less than 10 cm. long, about 2 mm. thick at the base, alate, having 2 vascular strands at the base, scaly, and without stipule-like outgrowths at the base; scales occurring only at the base.

Venation reticulate, rather indistinct; costa not raised, rather evanescent, but reaching the apex; lateral veins simple, oblique at an acute angle to the costa, almost parallel, numbering about 6 along a transverse line between the costa and the margin; vein-ends connected by a submarginal vein; areolae extending from the costa to the submarginal line, and without free included veinlets.

Sori multisporangiate, mixed, submarginal, confluent as long linear coenosori on receptacles (submarginal veins), sunken in longitudinal submarginal grooves, exindusiate and paraphysate; paraphyses abundant, brown, hair-like, clavate, branched, and with obovoid terminal cells.

Sporangia few per sorus, originating from single superficial cells, homosporous, subglobose and stalked; sporangiophore single-celled at the base but many-celled at the apex; sporangial wall of a single layer of cells; annulus longitudinal and incomplete; dehiscence transverse; spores 64 per sporangium, pale, hyaline, biplanate, smooth, and without perispore.

Herbaceous, small, generally epiphytic and grass-like fern of moist places in the plains and low elevations.

ORDER DICKSONIALES

Ferns of the Order Dicksoniales are terrestrial or epiphytic; some of them are even arborescent. The axis, too, varies accordingly. It may be an erect stock with radial symmetry and dictyostele; or a creeping rhizome, generally with a solenostele or sometimes with a modified protostele. It may also be generally hairy or occasionally scaly; and when scaly, the scales are narrow. The fronds are either clustered on a vertical stock, or arranged along a horizontal rhizome. They may be large or small, but invariably pinnately divided. They are generally not articulate to the axis. In texture, they are coriaceous in the dendritic forms, but herbaceous in the others. The margin may or may not be reflexed. The sori are orbicular and arranged only on the vein-ends, and are therefore generally submarginal, or even marginal at times. They may become confluent or somewhat so, however. They are generally mixed but sometimes gradate. They are indusiate with a distinct indusium which in combination with the margin, forms a *double indusium*. The sporangia are stalked, and the sporangiophores are long and generally have three rows of cells. The spores have no perispore. Three families are included, but only one of them, viz., Lindsaeaceae, is represented in the area.

Family Lindsaeaceae

Members of the Family Lindsaeaceae are generally terrestrial, but sometimes epiphytic, with a tender creeping dorsiventral rhizome which may be protostelic or solenostelic, and which has a covering of hairs or scales or both. The scales when present on the rhizome, are narrow, lanceolate, castaneous, shining and stiff. They consist of two to four rows of cells. The fronds are generally small and pinnately divided. They are stipitate but not articulate to the rhizome. The rachis is grooved. The pinnae are sometimes dimidiate, their basiscopic margins being decurrent on the rachis grooves. The margin is not reflexed. The veins divide generally sympodially. They may be either free, or anastomosing and forming oblique costal areolae without free included veinlets. The sori are submarginal and terminal on vein-ends. They may be simple and orbicular, or fused laterally as coenosori on submarginal vascular commissures which may connect the vein-ends. They are indusiate, the indusium being extrose and pouch-shaped or linear. The sporangia are stalked, the sporangiophores consisting of three rows of cells. The spores are tetrahedral or biplanate and have no perispore. Six genera are included but only one occurs in the area.

GENUS LINDSAEA DRYAND. *EX* J. SM.

Cut-border Ferns

Syn. :- *Pericopteris* Wall., *Synaphlebium* J. Sm., *Diellia* Brack., *Schizolepton* Fee, and *Schizoloma* Gaud.

Axis a creeping rhizome, terrestrial or amphibious, slender, 2 mm. to 4 mm. thick, short, dorsiventral, solenostelic or with modified protostele, and scaly. Scales on the rhizome castaneous, narrow, lanceolate, and stiff. Fronds arranged in 2 close rows on the rhizome, pinnate or bipinnate, unimorphous or dimorphous, small, herbaceous, and stipitate. Stipe slender, grooved on the adaxial side, sometimes quadrangular, with a single vascular strand at the base, and hairy. Hairs on the stipe simple, castaneous, narrow and stiff. Rachis grooved with narrow raised edges along the adaxial surface, and sometimes quadrangular along the abaxial surface. Pinnae glabrous, not articulate to the rachis, with basiscopic margin decurrent on rachis-grooves; either almost symmetrical around a prominent costa or almost fan-shaped without any costa, but never strongly dimidiate, in the case of pinnate fronds; and simple at the apex but gradually getting pinnate at the base and making the ambitus almost deltoid, in the case of bipinnate fronds. Pinnules of the bipinnate fronds usually fan-shaped or deltoid. Both pinnae and pinnules generally not many times longer than broad. Veins sympodially furcate and free or united marginally by the coenosori, or sparsely anastomosing and forming narrow areolae without included veinlets. Sori mixed, simple and orbicular or fusing and forming linear coenosori on submarginal commissures, and indusiate. Indusium membranaceous, pouch-shaped or linear, narrow and extrose. Sporangia stalked; sporangiophore long and slender, and consisting of 3 rows of cells. Annulus vertical. Dehiscence transverse. Spores varying from 24 to 32 per sporangium, pale, tetrahedral, smooth or minutely warty, and without perispore. Species 200, but only one in the area.

Lindsaea ensifolia Sw.

The Sword-leaved Cut-border Fern

(Plate XV)

Syn.:- *Lindsaea lanceolata* Lab., *L. membranacea* Kze., *L. attenuata* Wall., *L. longipinna* Wall., and *Schizoloma ensifolium* J. Sm.

Axis a creeping rhizome, short, dorsiventral, solenostelic (or with a modified protostele) and copiously scaly; scales castaneous, thin-walled, narrow, lanceolate, about 1·5 mm. long, shining, stiff, and not peltate at the base.

Fronds alternate in 2 rows on the rhizome, simple when young, becoming pinnate with a terminal pinna when old, subdimorphous (sterile fronds shorter than fertile ones) and stipitate; vernation circinate; ambitus lanceolate-ovate, 13 cm. to 60 cm. long, 3·5 cm. to 15 cm. broad, obtuse and cuneate; stipes approximate, not articulate to the rhizome, wiry, flexuose, about 7 cm. to about 30 cm. long, about 2 mm. thick, with 2 vascular strands at the base, ebenous, brownish proximally and yellowish distally but purplish when old, grooved along the adaxial side, without stipule-like outgrowths at the base, sparsely hairy proximally, and glabrous distally; hairs on the stipe brown, narrow and stiff; rachis grooved with narrow raised edges along the adaxial surface, and glabrous.

Pinnae simple, oblong-linear, sometimes somewhat unequilateral, generally from 3.5 cm. to 18 cm. long, 4 mm. to 25 mm. broad, stiff, herbaceous, glabrous, acuminate, obliquely truncate to cuneate (or unequal) at the base, subdimorphous and generally stalked; pinna-stalk yellowish, not articulate to rachis, short, about 5 mm. long and alate; lateral pinnae usually 4 and sometimes 2 to 10 per frond, smaller than the terminal pinna; sterile pinnae serrate and fertile ones minutely so.

Venation forking, anastomosing and forming one or more rows of oblique costal areolae on each side of the midrib without free included veinlets; the ultimate venules free in the sterile pinnae, but interconnected by a linear commissure along a submarginal line in the fertile pinnae.

Sori multisporangiate, submarginal, terminal on vein-ends, but fusing laterally to form linear continuous coenosori on submarginal commissures along the whole or part of the length of the margin, paraphysate and indusiate; paraphyses filamentous and septate; indusium membranaceous, linear, entire, persistent and extrose.

Sporangium originating from single superficial cells, homosporous and stalked; sporangiophore slender, consisting of 3 rows of cells; sporangial wall of a single layer of cells; annulus oblique; dehiscence transverse; spores varying from 24 to 32 per sporangium, pale, tetrahedral, smooth or minutely warty, and without perispore.

Small herbaceous fern frequenting generally the shady and swampy banks of hill-streams, sometimes making small stands; stray plants common in shallow and almost stagnant parts of rock-bound midstreams.

ORDER GLEICHENIALES

The Order Gleicheniales is a primitive one with many primitive characters. These ferns are generally terrestrial and thicket-forming. The fronds may be bipinnate, tripinnate or quadripinnate with a thick, dichotomously or pinnately divided rachis which may be alate. The pinnules are small and vary in shape. They may be interconnected by the wings of the rachis. The ultimate segments are short and linear-oblong with parallel or slightly converging margins. They may also be sometimes lobate and the lobes (when present) may be orbicular or linear. The lateral venules may be simple or furcate. The sori are orbicular and arranged on these venules. The sporangia are pyriform and their number varies from one to ten per sorus. They generally have an equatorial annulus.

This Order comprises two families, one containing only extinct genera of the Carboniferous period, and the other, viz., Gleicheniaceae, containing extant genera.

Family Gleicheniaceae

Members of the Family Gleicheniaceae are terrestrial, and some of them form dense thickets. The axis is a long, slender and creeping rhizome which is often branched. It is dorsiventrally symmetrical and has generally a simple protostele. Its apex has a covering of either stiff hairs or scales. The hairs are divided and the scales are generally peltate and fringed. The internodes are long. The fronds are long, large, solitary, straggling, thicket-forming, unimorphous, variously pinnate, rarely simple, and stipitate. They appear however to be dichotomously divided. The stipes are paleaceous or hairy, and not articulate to the rhizome. The pseudo-dichotomy of the frond is brought about by the rachis which is of indefinite growth and which, immediately after giving rise to one pair of lateral branches, terminates in a dormant bud. This bud remains dormant during the period of development of the preceding pair of lateral branches. It is protected by hairs or scales, and sometimes also by stipule-like leaflets. The primary branches of the rachis repeat the same process, but in different ways in different groups of these ferns. They may (i) remain unbranched with pinnately-arranged segments; or (ii) remain short and without segments like the main rachis itself, and bear a pair of branches with arrested terminal buds, and continue this process several times, and bear segments on the ultimate branches only; or (iii) branch repeatedly, and bear segments also on the branches below the terminal bud. The ultimate branches of the rachis in all these groups, are pinnatifid or bipinnatifid. The rachis is paleaceous or hairy. The ultimate segments of the frond are generally coriaceous, and lobate almost to the costa, the lobes being either short and rotund or long and narrow. The venation in each lobe consists of a pinnate

costule. The venules are furcate and free. The sori are exindusiate but contain branched scales or hairs. They are arranged in a single row on the middle of the venules on each side of the costule. Sometimes they may also be terminal on the venules. The sporangia are somewhat pyriform, large, superficial, placed generally around a small receptacle, or sunken in cavities, and very few in number (being two to fifteen or more per sorus), and have short sporangiophores. The annulus is oblique and complete; but the dehiscence is longitudinal. The spores are numerous (200 to 800 per sporangium), colourless, translucent, tetrahedral or biplanate. They have no perispore. The prothallus is green, flat and costate, and has glandular hairs. This Family is interesting in that its members are slowly disappearing from the Northern Hemisphere. Five genera are included but only one occurs in the area.

GENUS **DICRANOPTERIS** BERNH.

Iron Ferns

Syn. :- *Mertensia* Willd., *Calymella* Pr., *Sticherus* Pr., *Hicriopteris* Pr., *Gleicheniastrum* Pr., and *Gleichenia* Sm.

Axis a primitive rhizome, creeping, protostelic, and hairy when young. Hairs of the rhizome multicellular and stellate. Fronds with interesting architecture, pinnate but appearing to be dichotomously branched, and stipitate. Apices of the pinnae and axes of the pinnules ending in dormant hairy buds; preceding pair of lateral axes taking up further growth; pinnules pinnatifid, the lobes being linear and entire. Stipes and rachises sometimes hairy. Rachis variously branched —— **EITHER** (i) each branch bearing an accessory leaflet at the base and buds at the principal forkings; the ultimate branches alone being pinnular; accessory leaflets small, similar to the ultimate rachis-branches with pinnules, and deflexed; buds hairy, protected by a pair of (short, erect, simple, lobate and stipule-like) leaflets —— **OR** (ii) branches at each fork (excepting the 2 ultimate ones which bear the pinnules) unequal; the smaller ending in a pair of pinnular branches and a hairy terminal bud, the larger continuing further growth; the inequality alternating to the left and right and producing a zigzag course; each branch with a pair of accessory leaflets, and each principal branch having a pair of (short, erect, simple, lobate and stipule-like) leaflets for the protection of the bud; accessory leaflet similar to the ultimate rachis-branch, pinnular, and deflexed —— **OR** (iii) branches at each fork (excepting the 2 ultimate ones with pinnules) unequal, the smaller ending as a single branch with pinnules; zigzag growth somewhat straightened out; accessory branches suppressed; and hairy terminal buds present at forkings. Costules only one on each lobe; venules furcate at least twice. Sori generally multisporangiate, dorsal, orbicular, one on each vein group either side the costule, exindusiate and non-paraphysate. Sporangia 6 to 12 per sorus, multiseriate, large, homosporous, almost sessile, deciduous, and protected when young by hairs. Spores 120 to about 320 per sporangium. Considered by some authors as a subgenus of **Gleichenia** Sm., but recognized by some others as a separate genus. Species 10 but only 1 in the area.

Dicranopteris linearis (Burm. f.) Underw.

The Iron Fern

Syn.:- *Polypodium dichotomum* Thunb., *Gleichenia dichotoma* Willd., *G. flabellata* Lab., *G. lanigera* Don, *G. mucronata* Reinw., *G. rigida* J. Sm., *G. ferruginea* Bl., *G. linearis* Bedd., *Dicranopteris dichotoma* Bernh., *Mertensia dichotoma* Willd., *M. discolor* Schrad., *M. flexuosa* Mart., *M. hermanni* Poir., *M. sieberi* Pr., *M. crassifolia* Pr., *M. pumilla* Mart., *M. pusilla* Mart., *M. lessoni* Rich., *M. rigida* J. Sm., *M. hookeri* J. Sm., *Sticherus laniger* Pr., and *Mesosorus dichotomus* Hassk.

Axis a long rhizome, creeping, slender, protostelic and copiously hairy at the apex; hairs brown and divided.

Fronds solitary, pinnate but apearing to be dichotomously branched, straggling, unimorphous and stipitate; vernation circinate; stipes well-spaced on the rhizome, not articulate to it, erect, terete, of varying length, brownish, shining, without stipule-like outgrowths at the base, and hairy when young. Rachis pinnately branching, ending in a dormant bud after producing the first pair of primary branches, straggling, sometimes very long, and somewhat hairy; primary and subsequent branches of the rachis also ending in dormant buds after producing the first pair of lateral branches, and glabrous; dormant buds hairy, and protected by a pair of (erect, cordate, broadly lobate and stipule-like) leaflets; each rachis-branch having a deflexed accessory leaflet at the base; only the accessory leaflet and the ultimate rachis-branches pinnular. The pinnular branches in equal pairs of varying sizes, very deeply pinnatifid (almost to the costa); ambitus lanceolate and acuminate; lobes linear, more than 1 cm. long, glabrous, dorsally glaucous, obtuse or notched at the apex, entire, and copiously hairy when young; hairs brown.

Venation pinnate and free; costules 1 per segment; venules once to thrice furcate.

Sori multisporangiate, simple, dorsal, in a single row on the acroscopic branch of a vein, either side and near the costule, orbicular and exindusiate.

Sporangia varying in number, generally from 1 to 6 per sorus, sometimes 8 or more per sorus, originating from single superficial cells, homosporous, pyriform, and almost sessile; sporangial wall of single layer of cells in thickness; annulus oblique and complete; dehiscence longitudinal; spores numerous per sporangium, tetrahedral and without perispore.

Varieties many, not quite distinct; but only 1 in the area.

Dicranopteris linearis var. **linearis**

The Linear Iron Fern

(Plates XVI and XVII)

Syn.:- *Polypodium lineare* Burm. f., *Gleichenia hermanni* R. Br., *G. dichotoma* var. *normalis* Mett., *Mertensia pteridifolia* Pr. and *Gleichenia linearis* Clarke.

Axis a primitive rhizome, creeping, long and slender, 2 mm. to 3 mm. thick, branched dorsiventral, protostelic, and hairy when young; hairs multicellular, stellate, brown, caducous, and absent on older parts.

Fronds alternate, making an indistinctly-double row on the rhizome, polypinnate but presenting a pseudo-dichotomy, of indefinite growth, long, large, solitary, straggling, thicket-forming, unimorphous and stipitate; vernation circinate; stipes well spaced on the rhizome, not articulate, erect, terete, of indefinite growth, varying in length, 2 mm. to 2.5 mm. thick, brownish, shining, without stipule-like outgrowths at the base, and hairy; hairs multicellular, consisting of a single row of cells, sometimes upto 5 mm. long, caducous, and absent on older parts.

Rachis polypinnate, presenting a pseudo-dichotomy, of indefinite growth and length, scandent and somewhat hairy; main rachis and its branches ending in dormant buds after producing the first pair of branches; hairs on the rachis multicellular, consisting of a single row of cells, sometimes upto 5 mm. long, caducous, and absent on older parts; dormant buds of seasonal growth, copiously hairy, and protected by a pair of stipule-like leaflets; hairs on dormant buds multicellular and branched; stipule-like leaflets erect, upto 10 mm. long, cordate, and lobate at the base; primary branches of the rachis branched twice or thrice almost equally; primary and subsequent branches glabrous; lateral branches of the rachis having a pair of accessory leaflets at the base; accessory leaflets and ultimate rachis-branches pinnular; accessory leaflets deflexed.

Ultimate segments opposite and deeply pinnatifid (almost to the costa); ambitus lanceolate, about 15 cm. to 20 cm. long, 4 cm. to 6 cm. broad, glabrous, dorsally slightly glaucous, acuminate, almost truncate at the base, and stalked; lobes numerous, alternate, separated by sinuses, oblong-linear, upto 3·5 cm. long, upto 4 mm. broad, obtuse, entire, glabrous (but copiously hairy when young), and dorsally slightly glaucous; hairs brown; sinuses not extending upto the costa.

Venation visible only on the dorsal surface (and that too only slightly), pinnate, open, and sparsely hairy; costules only one on each lobe; venules at least twice furcate, and free; hairs on costules persistent, and much branched; hairs on the venules short, simple and caducous.

Sori generally multisporangiate, simple, dorsal, orbicular, arranged on the acroscopic branch of a vein in a single row either side the costules but never on vein-ends, non-paraphyate, and exindusiate.

Sporangia 1 to 8 per sorus, multiseriate, originating from single superficial cells, arranged around a receptacle, homosporous, pyriform, large, caducous, almost sessile, and protected by hairs when young; sporangial wall of single layer of cells in thickness; annulus oblique; dehiscence longitudinal; spores numerous per sporangium, tetrahedral, and without perispore.

Shrubby, thicket-forming, scandent (but not climbing high), and terrestrial fern of cool, shady and wet places on the sunny slopes of hills.

Useful (when growing in formation) to arrest soil-erosion; rhizome said to be anthelmintic, and the fronds germicidal; pinnules useful for button-holes and window-decorations and for providing shade in plant-nurseries; main rachis employed in other countries, for setting fish-traps and for making plaited objects.

ORDER BLECHNALES

Ferns of the Order Blechnales are terrestrial, some of them attaining an arborescent stature. They have short and stout stocks which are erect or nearly so, with a covering of scales. The fronds are clustered on the stock, and may be pinnate or bipinnate. They are coriaceous in texture. The bases of the stipes contain several vascular strands and have a covering of scales. The pinnae are unimorphous or subdimorphous and rarely lobate. The veins are generally free, but anastomose sometimes. The sori are short or long, linear coenosori which are borne on vascular commissures on the dorsal surface of the frond. They run generally in one but sometimes in two or three rows on each side of, and parallel to, the midrib. They are mixed with sporangia of all ages and are generally indusiate, the indusium being linear, membranaceous, introse and generally superficial. The sporangia are long-stalked and have each a longitudinal and incomplete annulus. They dehisce transversely. The spores are biplanate and few per sporangium, and may, or may not, have perispore. Only one family is included, viz., Blechnaceae.

Family Blechnaceae

Characters of this Family are the same as for the Order. Eight genera are included in it, but only one occurs in the area.

GENUS **BLECHNUM** L.

Hard Ferns

Syn.:- *Lomaria* Willd., *Stegania* R. Br., *Parablechnum* Pr., *Distaxia* Pr., *Mesothema* Pr., *Spicanta* Pr., *Blechnopsis* Pr., *Orthogramma* Pr., and *Blechnidium* Moore.

Axis an erect stock, short, stout, dictyostelic (of a complex kind) and scaly. Scales dark brown, shining, thin-walled, narrow, entire, and non-clathrate. Fronds pinnate, unimorphous and stipitate. Stipes not articulate to the stock, containing a ring of several vascular strands at

the base, and sometimes having small round auricles which are glandular when young. Pinnae oblong, sometimes very narrow (hardly extending beyond the indusium), entire or broadly dentate. Veins free and once or twice furcate. Vein-ends thickened in sterile fronds, and interconnected by vascular commissures in fertile ones. Sori dorsal, linear, borne in a single row on a continuous vascular commissure, close and parallel to the midrib, and indusiate. Indusium membranaceous, linear and introse. Spores biplanate. Species about 200, but only 1 in the area.

Blechnum orientale L.

The Eastern Hard Fern

(Plates XVIII, XIX and XX)

Syn.:—*Blechnum elongatum* Pr., *B. latifolium* Pr., *B. imbricata* Pr., *B. moluccanum* Roxb., *B. pyrophyllum* Bl., *B. javanicum* Bl., *B. imbricatum* Bl., *B. lomarioides* Gaud., *B. longifolium* Cav., *B. orientale* J. Sm., *B. orientale* Lamk., *B. pectinatum* Spr., *B. salicifolium* Klf., *B. stenophyllum* Fee, *Asplenium orientale* Bernh., *Blechnopsis elongata* Pr., *B. latifolia* Pr., *B. orientalis* Pr., *B. cumingiana* Pr., *B. pectinata* Pr., *B. salicifolia* Pr., *B. stenophylla* Pr., *Salpichlaena orientalis* Fee, and *S. cumingiana* Fee.

Axis an erect and stout stock, generally protruding out of the soil, short with radial symmetry, about 5 mm. thick, dictyostelic and copiously scaly; scales dark brown, shining, thin-walled, flat, linear, entire, non-clathrate, acuminate, 5 mm. to 15 mm. long and about 1 mm. broad at the base.

Fronds spirally clustered, pinnately divided, unimorphous and stipitate; vernation circinate; ambitus oblong-lanceolate, 25 cm. to 120 cm. long, 10 cm. to 45 cm. broad, and acuminate; stipes spirally-clustered on the stock, not articulate to it, erect, about 5 cm. to 40 cm. long, stout, having a ring of several vascular strands at the base, varying in thickness, strong, glabrous distally and scaly proximally, and without stipule-like outgrowths at the base; scales on the stipe dark brown, shining, linear, acuminate, 5 mm. to 15 mm. long; rachis glabrous.

Pinnae numerous, contiguous, subopposite at the apex and alternate at the base, linear-lanceolate, tapering out from a broad and oblique base, coriaceous, glabrous, acuminate, entire, decurrent or at times truncate at the base, without stipule-like outgrowths at the base, and sessile; terminal pinnae elongate, about 18 cm. long and 1·5 cm. broad, and decurrent; lateral pinnae 5 cm. to 21 cm. long, and 5 mm. to 18 mm. broad; basal pinnae abhortive, squamiform, reduced to oblong auricles, and 1 cm. to 3 cm. apart from one another.

Venation pinnate and thin; venules very approximate, free, furcate and nearly parallel; vein-ends thickened in sterile fronds, and interconnected by subcostal commissures and by distal veins in fertile fronds.

Sori multisporangiate, mixed, dorsal, confluent as narrow linear coenosori in single rows, on subcostal commissures, parallel and close to the costa, and indusiate; indusium membranaceous, subcostal, linear, persistent and introse.

Sporangia originating from single superficial cells, homosporous and stalked; sporangiophore of 3 rows of cells; sporangial wall of a single layer of cells; annulus longitudinal and incomplete; dehiscence transverse; spores pale, biplanate, usually smooth, alate, and having perispore.

Small, terrestrial to subarborescent, shade-loving, and palm-like fern; generally close to water-courses on hill-sides or ravines.

Ornamental plant; the rhizome said to be used as an anthelmintic in China, and the leaves for making poultice in Malaysia.

ORDER POLYPODIALES

Ferns of the Order Polypodiales are either terrestrial and thicket-forming, or epiphytic; and flourish at higher elevations. Their axes are creeping rhizomes, and either hairy or scaly, but never glabrous. They are generally protostelic but sometimes solenostelic or dictyostelic. The scales when present, are generally peltate. The fronds are solitary and not clustered on the rhizome. They are generally simple, or dichotomously furcate, or sometimes pinnate. They are also generally articulate to the rhizome. The sori are dorsal and may be punctiform, orbicular, oblong, or (rarely) acrostichoid; and when oblong, they may be parallel to the midrib; and when not acrostichoid, they may be terminal or subterminal on free veins, or compital on anastomosing veins. As a rule, they are exindusiate and mixed, containing sporangia of all ages. In some cases however they have paraphyses for their own protection. The sporangium has a longitudinal and incomplete annulus, and dehisces transversely, liberating a few spores which have no perispore. The prothallus is green and typically cordate. Four families are included, but only one of them, viz., Polypodiaceae, is rather doubtfully represented here.

Family Polypodiaceae

Members of the Family Polypodiaceae are generally epiphytic, and thrive in moist tropical forests. They are of a small or medium size and have a typically fern-like form. Their axis is a creeping and dictyostelic rhizome which is covered with broad, clathrate, dentate and peltate scales, and which has a dorsiventral symmetry. The fronds are stipitate, simple, entire or pinnatifid to pinnate, coriaceous and rarely pubescent. The stipes are articulate to the rhizome. The venation is generally diplodesmic and reticulate with free included veinlets in the areolae. The sori are pleosori or dictyosori, or (rarely) somewhat oblong and fusing to form coenosori, on the abaxial surface of the lamina, and confined generally to vein-junctions; but sometimes they spread along the veins and thus become acrostichoid. They may have sometimes filiform paraphyses. The sporangia are pyriform or globose-pyriform, and have long sporangiophores with three rows of cells in each. Their annulus is longitudinal and incomplete. Their dehiscence is transverse. The spores are biplanate and smooth or sometimes warty, and have no perispore. There are over forty genera in this Family, which face constant revision; but only one genus is recorded in the area.

GENUS **PLEOPELTIS** HUMB. *ET* BONPL.

Polypody

Syn. :- *Atactosia* Bl., *Anapeltis* J. Sm., *Lepisorus* (J. Sm.) Ching, *Phyllitidis* J. Sm., *Dryomenis* J. Sm., *Dipteridis* J. Sm., *Chrysopteris* Link, *Microsorium* Link, *Microgramma* Pr., *Pleuridium* Pr., *Phymatodes* Pr., *Microterus* Pr., *Colysidis* Pr., *Selluguia* Pr., *Anaxetum* Schott, *Symplecium* Kze., *Mecosorus* Kl., *Tectaria* Cav., *Marginaria* Bory., and *Drynaria* Fee.

Axis creeping, long, woody, dictyostelic and scaly. Scales of the rhizome ovate, oblong, lanceolate, linear, subulate or (rarely) orbicular. Fronds scattered or (rarely) clustered, simple or pinnatifid, linear-lanceolate, generally unimorphous, but sometimes (when pinnatifid) dimorphous, coriaceous, generally glabrous but sometimes scaly, entire and stipitate. Stipe articulate to the rhizome, and having no stipule-like outgrowths at the base. Scales (when present on the frond) scattered, peltate, orbicular or lanceolate, appressed, usually fringed, and non-clathrate. Venation reticulate but sometimes evanescent. Main veins pinnate from a central costa. Venules branching and anastomosing copiously to form series of hexagonal areolae with free included veinlets. Veinlets spreading in various directions. Vein-ends clavate. Sori dorsal, mixed, sunken, orbicular or somewhat elliptical or sometimes drymoglossoid, confined to venation, generally terminal on the veins, or (if elliptical) always parallel to the costa, exindusiate, and paraphysate at least when young; paraphyses flat, long-stalked, broad distally, and peltate. Sporangia with sporangiophores of 3 rows of cells each; spores biplanate, hyaline to orange-coloured, and without perispore. Species about 40, but only 1 recorded in the area.

Pleopeltis Linearis (Thunb.) Bedd.

The Linear Polypody

(Plate XXI)

Syn.:– *Polypodium loriforme* Hk., *P. astropunctatum* Hk., *P. leiopteris* Kze., *P. nudiusculum* Kze., *P. phlebodes* Kze.. *P. accutissimum* Wall., *P. sesquipedale* Wall., *P. contiguum* Wall., *P. wightianum* Wall., *P. gladiatum* Wall., *P. excavatum* Willd., *P. lineare* Thunb., *P. gueintzii* Mett., *Pleopeltis nuda* Hk., *P. elongata* Klf., and *P. wightiana* Wall.

Axis horizontal, creeping, long, woody, dorsiventral, dictyostelic, 2 mm. thick, black, and scaly; scales dirty brown, oblong, acuminate, 4 mm. long, clathrate, dentate and peltate.

Fronds scattered and solitary but in 2 rows, simple or pinnatifid (with broad sinuses), lanceolate to linear-lanceolate, narrowing gradually at both ends, about 25 cm. long, from 5 mm. to 20 mm. broad at the widest part (larger sizes on record elsewhere), coriaceous, glabrous ventrally, sparsely hairy or scaly dorsally (when young), acuminate, entire or somewhat subsinuate, unimorphous and stipitate; vernation circinate; scales (when present on frond) peltate, non-clathrate and appressed; stipe articulate to the rhizome, 2·5 cm. long, 1 mm. thick, incompletely alate on both sides on account of the thin diminishing extensions of the lamina, without stipule-like outgrowths at the base, and glabrous.

Venation reticulate, but indistinct when dry; veins branching pinnately from a central costa; venules branching, anastomosing and forming large irregular costal areolae with free furcate and variously-directed included veinlets; vein-ends clavate.

Sori multisporangiate, superficial, prominent, mixed, orbicular or somewhat oblong, varying in size, polypodioid, uniseriate on each side of and nearer to the costa, compital and exindusiate but paraphysate when young; paraphyses copious, caducous long-stalked, thin and peltate.

Sporangia few per sorus, originating from single superficial cells, globose-pyriform, homosporous and stalked; sporangiophores long and of 3 rows of cells each; sporangial wall of single layer of cells; annulus longitudinal and somewhat complete but without a well-defined stomium; dehiscence transverse; spores few per sporangium, yellowish, biplanate and without perispore; prothallus green and cordate.

Small perennial herb adhering to the rocks, etc. on hill-slopes, somewhat epiphytic, often in association with mosses and liverworts; conserving moisture in drought by twisting and curling up the fronds. Not collected by the writer; but preserved in some of the college herbaria and reported to have been collected on the Kambakam Hills. A wide-spread dispute present in the treatment of this species.

Helpful in soil-binding while in association with other plants.

Subclass Marsileidae

The members of the Subclass Marsileidae are either hydrophytic or amphibious, with solenostelic and branched rhizomes which may be long and creeping, or short and ascending, and which are hairy in young and shallow-water forms or somewhat so in old and deep-water ones. They are generally overlooked in the field as they merge with the tiny herbaceous flowering plants. They grow rooted in mud at the bottom of shallow pools and ditches, or swampy soils, or on moist earth which has subsequently and (only) temporarily become dry. The internodes are long on creeping rhizomes, but very short on ascending ones. The fronds are simple or pinnate, with circinate vernation. They are arranged in two opposite rows on the rhizome; but their arrangement is however rosette-like in the forms with ascending rhizomes, because of the much-reduced internodes. They may or may not have laminae. The fertile pinnae are highly specialized and developed as sporocarps which are borne either singly or in

bunches at the bases of the stipes, and which contain the sporangia. The venation is reticulate, the veins dividing freely and anastomosing at the ends. The sporocarps are hard, tripple-walled and hairy. They may be ovate (or globose), or oblong-ovate in shape. The plants are heterosporous. There are two or more heterosporangiate sori inside each sporocarp which represents a segment of the frond. The sporocarps open by one or four slits. The sporangia develop from single superficial cells, and their outer walls are of a single layer of cells in thickness. Each microsporangium produces numerous (multiple of 4) minute microspores, but each megasporangium produces only one large megaspore with a thick coating of mucilage. The spores are tetrahedral. The microspores germinate into microprothalli which produce only antheridia, and the megaspores into megaprothalli which produce only archegonia. The prothalli of both these kinds are much reduced, parasitic on the spore, and rather evanescent. The antheridia are raised above, but not sunk in, the prothallial tissue. This Subclass comprises only one order, viz., Marsileales.

ORDER MARSILEALES

Characters of the Order are the same as for the Subclass. Only one family is included, viz., Marsileaceae.

Family Marsileaceae

Characters of this Family are the same as for the Order. Three genera are included in it but only one occurs in the area.

GENUS MARSILEA L.

Pepperworts

(Plate XXII)

Syn. :- *Lemna* Juss., and *Zaluzanskia* Neck.

Hydrophytic or amphibious, vegetating in the wet season, and producing sporocarps in the dry season. Axis a creeping rhizome, slender, branching and rooting only at the nodes, dorsiventral, with large air-spaces, and siphonostelic; siphonostele amphiphloic. Roots branched or unbranched, one or more per node, and containing air-spaces. Fronds spaced out on long rhizomes or closely clustered on short lateral branches of the rhizome, alternate but arranged in two opposite rows on the rhizome, pinnately divided, floating in deep-water forms and erect in shallow-water forms, hairy and stipitate; vernation circinate; hairs multicellular. Stipe with only one and V-shaped vascular strand at the base, generally very long in deep-water forms. Pinnae dimorphous. Sterile pinnae of fronds (with, or near, sporocarps) generally small; sterile pinnules 4, alternate but arranged so close together as to appear to radiate from a central point and to accord a clover-like appearance to the ambitus of the pinna, floating, horizontal, obovate, herbaceous, obtuse, sometimes dentate at the apex, crenate at the base, and minutely stalked. Fertile pinnae highly specialized and developed into sporocarps. Sporocarps developing only on parts in muddy or dry grounds and away from water, aerial, not submersed, oblong, three-walled, vertically ribbed at the sides, solitary or in bunches, green and hairy when young but hard brown and glabrous when old, heterosporangiate, disintegrating and opening at the free ends, and pedicellate; hairs multicellular; pedicels short, connate or adnate at the base. Venation somewhat reticulate; veins thin, dichotomously dividing but loosely inter-connected laterally and marginally and thus forming areolae; areolae irregular, narrow and radiating. Dark lines sometimes present between the veins. Sori arranged in 2 rows inside the sporocarp, gradate, heterosporangiate, and indusiate; receptacle ridge-like, in a mucilaginous envelope between the veins inside the sporocarp, soon gelatinizing and getting detached from the surface and flowing out as a sorophore with the mucilage after the decay of the wall of the sporocarp; indusium delicate, bilayered, partially fusing with the adjacent ones within the sporocarp and forming a hollow. Sporangia arising from single superficial cells, and of 2 kinds (microsporangia

and megasporangia), and stalked; sporangiophore long and thin for microsporangia, and short and thick for megasporangia; sporangial wall of a single layer of cells, decaying and liberating the spores; annulus absent; spores commencing development even before liberation into water by the break-up of the gelatinous indusium, and of 2 kinds: microspores and megaspores; microspores varying in number, 32 or 64; megaspores ellipsoid, only 1 ultimately developing per sporangium, or replaced by spores of different types in some abnormal cases, or accompanied by small pseudospores in the same megasporangium in other abnormal cases. Prothallus considerably reduced and difficult of detection, producing only antheridia or only archegonia. Species 60, arranged in 3 groups; but only 1 group represented in the area.

MINUTA GROUP

Hydrophytes, often amphibious; sporocarps ovate or oblong-ovate, and either solitary or more than 1 per node; pedicels close to the rhizome, slightly connate or free. Species numerous, but only 2 in the area.

Marsilea minuta L.

The Minute Pepperwort

(Plate XXIII)

Syn.:- *Marsilea erosa* Willd., *M. aegyptiaca* Wall., *M. dentata* Roxb., *M. fournieri* C. Chr., *M. poonensis* Kolhat.

Axis a rhizome, creeping and long with long internodes, or sometimes ascending and short with much-reduced internodes, slender, 1 mm. thick, dorsiventral, stoloniferous, of indefinite growth, siphonostelic, branching and rooting only at nodes, and hairy in young and shallow-water forms or somewhat so in old and deep-water ones; siphonostele amphiphloic; roots branched or unbranched and one or more per node; hairs jointed, slender and caducous.

Fronds alternate but arranged in 2 opposite rows on the rhizome, pinnately divided, hairy, and stipitate; vernation circinate; stipes spaced out on the rhizome when creeping but clustered on it when ascending, varying in length according to aquatic conditions, erect when short, slender, 0·5 mm. to 1 mm. thick, with only one vascular strand at the base, almost hairy, without stipule-like outgrowths at the base, and bearing sporocarps at the base in the case of fertile fronds; pinnae dimorphous; hairs multicellular.

Sterile pinnules 4, alternate, but generally contiguous and so closely arranged as to appear to radiate from an almost common point and to accord a clover-like appearance to the pinna, simple, broadly obovate, from 3 mm. to 20 mm. long, from about 2 mm. to 12 mm. broad, generally smaller when with or near sporocarps, herbaceous, glabrous ventrally, hairy dorsally, obtuse, cuneate, entire alround, or entire only laterally and serrate crenate or undulate at the apex, and minutely stalked.

Fertile pinnae highly specialized and forming sporocarps; sporocarps developing at the bases of stipes but only on parts wandering on muddy or drier grounds and away from water, aerial, not submersed, usually in bunches of 3 each, sometimes also in bunches of 2 or 4 each, oblong-ovate, from 3·5 mm. to 5 mm. long, from 2·5 mm. to 3 5 mm. broad, tri-walled, green when young but hard and brown when old, bordered, disintegrating and opening generally at the free ends, pedicellate, bicornate, sparsely hairy, ribbed, erect when ripe, and monoecious with about 8 to 10 heterosporangiate sori in each; pedicels slightly connate at the base, varying in length, 3 mm. to 5 mm. long from the point of connation, slender, close to the rhizome, and connected to the sporocarp with a broad raphe; horns 2, spine-like, one below the other at the attachment of the pedicel, and pointing downwards; hairs multicellular and caducous; ribs 4 to 6 on each side, and transverse.

Venation radial; costa absent; venules dichotomously dividing and anastomosing at the ends to form areolae; areolae irregular, narrow and radiating.

Sori multisporangiate, 8 to 10 per sporocarp, gradate, heterosporangiate, and indusiate; receptacle between the veins of the sporocarp, ridge-like, covered by mucilage in the indusial hollow, soon gelatinizing and detaching from the inner surface of the sporocarp and flowing out as a sorophore with mucilage and with both the kinds of sporangia on decay of the sporocarp wall; indusium bilayered, partially fusing with the adjacent indusium within the sporocarp and forming a hollow.

Sporangia originating from single superficial cells in the sporocarp, stalked, and of 2 kinds: microsporangia and megasporangia; sporangiophore long and thin for microsporangia, and short and thick for megasporangia; sporangial wall of single layer of cells, and decaying and liberating the spores; annulus absent; spores tetrahedral, developing even before liberation into water, and of 2 kinds: microspores and megaspores; microspores minute and numerous per microsporangium; megaspores large, ellipsoid, with a thick coating of mucilage, and only one per megasporangium.

Prothallus much reduced, parasitic on nutrition in the spore, and monoecious.

Small, amphibious, slender but pioneering and herbaceous fern chiefly of paddy-fields and ditches; rooted in mud and widely varying in form and structure.

Edible; fronds cooked and eaten like greens; sporocarps rich in starch.

Marsilea coromandelica Burm. f.

The Coromandel Pepperwort

(Plate XXIV)

Syn.:- *Marsilea quadrifolia* Burm. f., *M. coromandelina* Willd., *M. longipes* Bory., and *M. minuta* var. *coromandeliana* Linn.

Axis a creeping rhizome, long, slender, 0·5 mm. thick, stoloniferous, dorsiventral, siphonostelic, branching and rooting only at the nodes, with long internodes, and sparsely hairy; siphonostele amphiphloic; roots branched, one or more per node; hairs colourless, very slender, and caducous.

Fronds alternate, arranged in two opposite rows on the rhizome, pinnate, small, hairy and stipitate; vernation circinate; stipes spaced out on the rhizome, varying in length, very slender, less than 0·25 mm. thick, having only one vascular strand at the base, almost glabrous, bearing sporocarps singly at the base, and having no stipule-like outgrowths at the base; hairs multicellular; pinnae dimorphous; sterile pinnae (of fronds with or near sporocarps) generally smaller and erect.

Sterile pinnules alternate, but generally contiguous and so closely arranged as to appear to radiate from an almost common point and to accord a clover-like appearance to the pinna, simple, broadly obovate, small, about 9 mm. long, about 9 mm. broad, generally smaller when with or near sporocarps, herbaceous, glabrous, streaked with interstitial sclerenchyma, obtuse and sometimes slightly dentate at the apex, entire, cuneate and minutely stalked.

Fertile pinnae highly specialized and forming sporocarps; sporocarps developing at the bases of the stipes, only on parts wandering away from water, aerial and not submersed, solitary, oblong-ovate, about 3·5 mm. long, about 3 mm. broad, sometimes twice as long as broad, strongly curved in the middle, triwalled, green when young but hard and brown when old, distinctly bordered, disintegrating and opening generally at the free ends, pedicellate, bicornate, sparsely hairy, ribbed at the sides, erect when ripe, and monoecious with about 8 to 12 heterosporangiate sori in each; pedicel solitary, free, varying in length, generally about 12 mm. long or about 4 to 5 times as long as the sporocarp, slender, close to the rhizome, and connected to the sporocarp with a narrow raphe; horns 2, obliquely placed at the upper part of the proximal end of the sporocarp, and pointing downwards; hairs multicellular and caducous; ribs 4 to 7 on each side of the sporocarp, and vertical.

Venation radial; costa absent; venules dichotomously dividing and anastomosing at the ends to form areolae; areolae irregular, narrow and radiating; dark streaks of interstitial sclerenchyma sometimes present between the veins.

Sori multisporangiate, 8 to 12 per sporocarp, gradate, heterosporangiate, and indusiate; receptacle between the veins inside the sporocarp, ridge-like, covered by mucilage in the indusial hollow, soon gelatinizing and detaching from the inner surface of the sporocarp and flowing out as a sorophore with the mucilage and both the kinds of sporangia on decay of the sporocarp-wall; indusium bilayered, partially fusing with the adjacent indusium within the sporocarp and forming a hollow.

Sporangia originating from single superficial cells in the sporocarp, stalked, and of 2 kinds: microsporangia and megasporangia; sporangiophore long and thin for microsporangia, and short and thick for megasporangia; sporangial wall of single layer of cells, decaying and liberating the spores; annulus absent; spores tetrahedral, developing even before liberation into water, and of 2 kinds: microspores and megaspores; microspores minute, and numerous per sporangium; megaspores large, ellipsoid, with a thick coating of mucilage, and only 1 per megasporangium.

Prothallus much-reduced, parasite on the nutrition in the spore, and monoecious.

Small, amphibious, slender, delicate and herbaceous fern; growing rooted in mud in the coastal tracts.

Edible; fronds cooked and eaten like the greens; sporocarps rich in starch.

Subclass Salviniidae

The members of the Subclass Salviniidae are very minute, heterosporous and floating hydrophytes. Their minuteness renders them difficult of recognition and collection from the midst of the numerous other forms of aquatic vegetation. The axis is very slender and branched, floats horizontally, and contains only a single vascular strand. The fronds are alternate, densely imbricate in arrangement, and erect (but not circinate) in vernation. The venation is reticulate. The sori are globose and dioecious (some of them containing only microsporangia and some others only megasporangia). They are indusiate, the indusium being globose, persistent, enclosing the sorus, and thickening and forming an indehiscent dioecious sporocarp. The microsporangial sorus is large and the microsporangia are numerous and long-stalked, and produce 64 microspores per sporangium. The megasporangial sorus contains only one large megasporangium which is short-stalked, and which produces only one megaspore. The sporangia develop from single superficial cells, and have walls of a single layer of cells in thickness. They are arranged basipetally on a cylindrical receptacle, and do not have any annulus, nor do they dehisce. Decay of the indusium and the sporangial wall, liberates or exposes the microspores or the megaspores as the case may be. The microspores germinate into microprothalli which produce the antheridia, and the megaspores into megaprothalli which produce the archegonia. Both the kinds of prothalli are much reduced, parasitic on the nutrition in the spore, and evanescent. This Subclass comprises only one order, viz., Salviniales.

ORDER SALVINIALES

Characters of the Order are the same as for the Subclass. Two families are included, but only one, viz., the Azollaceae, is represented in the area.

Family Azollaceae

Members of the Family Azollaceae are minute and floating hydrophytes with slender, branched and zigzag axes which produce numerous pendulous roots from the undersurface at

the branching-points. The root-caps decay and disappear early. A pair of fronds arise from each node, one opposite the other. But later on, the fronds are seen very closely and alternately arranged in two rows on the axis. They are not circinate but erect in bud. They are very small and microscopic and less than a millimetre long. They are unimorphous, sessile and simple, but deeply bilobate. Of the two lobes, one keeps floating, and the other remains submersed, in water. The floating lobe fully overlaps and hides the axis, and forms a hollow at the base. The hollow opens out by a small pore, and contains some mucilage and a filamentous alga (**Anabaena azollae**). The submersed lobe is thin and only partially overlaps the axis without hiding it. Only those submersed lobes which are nearest the bases of the branches are fertile and bear the sporocarps. The venation is reticulate, with generally a prominent costa in each lobe. The sori are terminal on the veins and two per submersed lobe of the frond. They are indusiate; and the indusium hardens and forms a sporocarp enclosing the sorus in it. Of the two sporocarps in each pair, one contains numerous microsporangia, and the other only one megasporangium. Each microsporangium liberates 64 microspores which join together into a massula in a hardening mucilage (a modified perispore). Each massula has curiously "barbed" hairs, and floats about. Each megasporangium contains only one megaspore. It sinks to the bottom of the water, and on the decay of its indusium, liberates the megaspore, the perispore of which grows into three small floats. It has a warty and hairy surface. The megaspore germinates into a reduced, tiny and floating megaprothallus which produces several archegonia. Each archegonium has only one female germ cell. The massulae attach themselves by their barbs, to the megaprothallus. The microprothalli are even more reduced, each producing only one antheridium which does not come out of the spore but remains inside and sends out only the male germ cells to fertilize the female germ cells of the megaprothallus. This is a monogeneric family.

GENUS AZOLLA LAMK.

Floating Ferns

Syn.:- *Carpenthus* Raf. and *Rhizosperma* Meyr.

Characters of this Genus are the same as for the Family. Species 5, but only 1 in the area.

Azolla pinnata R. Br.

The Feather-leaved Floating Fern

(Plate XXV)

Syn.:- *Salvinia imbricata* Roxb.

Axis floating, horizontal, of zigzag growth, dorsiventral, upto about 2 cm. long, very slender, pinnately branched, rooting at the branching-points, protostelic, and glabrous; branches varying in length, over 4 mm. long, distichous, slightly oblique, the interval between the branches on the same side being about 2 mm.; protostele amphicribral; roots hanging freely from the undersurface of the branching-points of the axis in water, not attaching to substratum, numerous and pinnately branched.

Fronds alternate, arranged closely in 2 rows on the dorsal surface of the axis, simple but deeply bilobate, broadly obovate, microscopic, less than 1 mm. long, relatively succulent, papillose ventrally, glabrous dorsally, unimorphous, turning dull red when old, sessile, and without any stipule-like outgrowths at the base; vernation erect and not circinate.

Lobes oblong-obovate, brittle, acute, incurved at the apex, entire and cuneate; one lobe floating, fully over-lapping and hiding the rhizome, and forming a small hollow at the base; the hollow generally containing mucilage and **Anabaena azollae** (a filamentous alga), and opening out by a small pore; the other lobe submersed in water, thin, lightly over-lapping at the base but not hiding the rhizome; only the submersed lobe of the first frond of the branch fertile,

Venation reticulate; costa only 1 per lobe and indistinct; veins anastomosing and forming areolae; areolae narrow, oblong and without included veinlets.

Sori dioecious, globose, terminal on the veins, 1 pair per submersed lobe of the first frond of the branch, and indusiate; indusium globose, persistent, enclosing the sorus and forming a sporocarp; sporocarps dioecious, indehiscent, only 1 pair per fertile lobe, dimorphous, one in each pair containing numerous microsporangia, and the other containing only 1 megasporangium; microsporocarp larger than megasporocarp.

Sporangia bilaterally arranged on cylindrical receptacles, originating from single superficial cells, stalked and of 2 kinds: microsporangia and megasporangia; microsporangia numerous per sorus, but megasporangia only one per sorus; sporangiophore long for microsporangium but short for megasporangium; sporangial wall of a single layer of cells; annulus absent; microspores liberated by the decay of the walls of the sporocarp and the sporangium, 64 per microsporangium (but emerging as 1 hairy and floating mass from each microsporangium), and getting attached to the megaspores; hairs barbed; megaspores exposed by the decay of the walls of the sporocarp and the sporangium, only 1 per megasporangium, having 3 small floats each, hairy and with warty surface; perispore modified into hardening mucilage for the massulae in the case of microspores, and into floats and hairs in the case of megaspores.

Prothalli from microspores much reduced, parasitic on the spore, not coming out of it (spore) but remaining inside it and sending out only the male germ cells; those from megaspores very minute, floating, and generally producing only 1 archegonium each.

Minute, hydrophytic, prolific, herbaceous, moss-like and floating ferns, easily mistaken for Duckweed (**Lemna** L.); in the lakes, tanks, etc. of the plains and low elevations, particularly during the rainy seasons; broken units of old plants becoming new and independent plants.

Useful in culture of fishes and maintenance of aquaria; and in Nitrogen-fixing in paddy-culture; and in control of water-weeds in ponds and pools.

APPENDIX I

HINTS FOR FERN COLLECTORS

Methods of collection and preservation of other plants, especially the higher-evolved ones, can be freely adopted in the case of the ferns also. They are described in detail in other works. In these pages however, a brief account of the peculiarities of the individual ferns described in the text, is given.

Actiniopteris radiata can be kept alive for a number of weeks in a vase, if it is properly anchored and carefully watered. The water should not stagnate but drain off quickly, and the plant should not be disturbed in the process. The plant keeps better if exposed to the sun for one half of the day.

Actiniopteris radiata, Adiantum caudatum, Pleopeltis linearis and all the species of **Cheilanthes** and **Marsilea,** when required for the herbarium, need a little manipulation before they are subjected to pressure. Otherwise, the fronds of **Actiniopteris** and **Marsilea** droop, and those of the rest twist and curl badly, and all of them make poor specimens on herbarium sheets. To prevent such reactions in them, the fronds of these plants are spread out in the manner natural to them on the driers and pressed in the portfolio immediately on the spot as soon as they are collected in the field. In the case of the different species of **Marsilea** growing in wet situations, the fronds have to be wiped dry with a clean cloth or blotting-paper, before placing in the portfolio.

Angiopteris evecta, Lygodium scandens, Dicranopteris linearis, Lindsaea ensifolia, Hemionitis arifolia, Cheilanthes farinosa, Vittaria elongata, Blechnum orientale and **Pleopeltis linearis** have fronds which are often too long to go into the herbarium sheet. Their fronds are therefore bent to and fro, so as to be accommodated within the size of the herbarium sheet, even as they are first subjected to pressure in the driers. When this is done, care should be taken to see that no part overlaps any other part. The fronds of full-grown **Blechnum orientale** will not yield to this manipulation. They should therefore be cut up, and their different parts should be preserved separately and mounted on separate herbarium sheets.

Hemionitis arifolia, Vittaria elongata, Pleopeltis linearis and young specimens of **Dicranopteris linearis** may also be preserved in a different way for any ornamental setting. They may be kept immersed for a few days in a 25% solution of glycerine in 2% formalin, keeping the container open so as to facilitate evaporation of water and gradual increase in the proportion of glycerine. They may be hung up and dried in shade without pressure. They may be painted over afterwards in the manner natural to them.

Ophioglossum nudicaule is too small for the normal herbarium sheet. A half-a-dozen of these plants can be accommodated conveniently on each sheet.

Azolla pinnata is even more minute and therefore unsuitable for the herbarium. Nevertheless, when occurring on damp soils and when required for the herbarium, it is pressed and dried with its substratum *in situ*, and then mounted on the herbarium sheet. It is best preserved in formalin or in form-acetic-alcohol.

All the ferns dealt with in this work, with the exception of **Azolla pinnata,** can be preserved with colour in formalin. For this purpose, they are first kept immersed for a week in a saturated solution of copper sulphate in 10% formalin, and then washed and preserved in 5% formalin. This keeps their colour indefinitely. Specimens, too big for the jar, are cut up and their different parts are preserved in separate jars.

APPENDIX II

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APPENDIX III

GLOSSARY

ABAXIAL. That which is turned away from the axis (eg., the under-side of a leaf or frond).

ABNORMAL. Not of regular specifications or pattern.

ABORTIVE. Imperfectly developed or under-developed.

ABSORPTION. Sucking in of fluids; up-take of nutrient solution from the soil.

ACCESSORY. That which is additional to the normal; extra.

ACROSCOPIC. That side of the lamina of a segment, which is towards the apex of the frond and which is bounded by the midrib and the margin.

ACROSTICHOID. Spread over the whole surface of the lamina (applicable to sori).

ACUMINATE. Tapering to a point.

ACUTE. Ending in a sharp point suddenly but not abruptly and without any tapering.

ADAXIAL. That which is turned towards the axis (eg., the upper side of a leaf or frond).

ADNATE. Intimately merging with, or attaching to, another structure of a different kind from the beginning of development.

AERIAL. Growing and functioning above the surface of the ground and exposed to the air.

ALATE. Having one or more, thin, broad, surrounding or bordering expansions.

ALTERNATE. Placed at different levels around the supporting axis.

ALTERNATION OF GENERATIONS. Alternation of a diploid spore-producing phase and a haploid gamete-producing phase in the life-cycle of a plant.

AMBITUS. General appearance presented by the margin of a divided frond, pinna, pinnule, etc., if such a frond, pinna, pinnule, etc. were not divided; figure formed by the margin.

AMPHIBIOUS. Growing both in water and on land.

AMPHICRIBRAL. With phloem surrounding the xylem.

AMPHIPHLOIC. Having phloem both on the inner and on the outer sides of the xylem.

ANADROMICALLY. On the side towards the leaf-apex.

ANASTOMOSING. Smaller divisions of a larger unit getting reunited at points of contact (Applicable only to veins).

ANNUAL. Completing the life-cycle and dying out within one year.

ANNULI. Plural form of annulus.

ANNULUS. A row of specialized cells in the wall of a sporangium, the contraction of which causes rupture of the sporangium and dispersal of the spores.

ANTHELMINTIC. Drug acting against helminths, and used in the treatment of worm-infections.

ANTHERIDIA. Plural form of antheridium.

ANTHERIDIUM. Structure in which spermatozoids are produced.

APEX. Tip.

APICAL. Pertaing to apex; situated on top.

APICES. Plural form of apex.

APPRESSED. Lying tightly against another organ which is usually larger; lying flat on the surface.

APPROXIMATE. Arranged near each other.

AQUATIC. Pertaining to, or growing in, water.

ARBORESCENT. Large and more or less tree-like but without a distinct single trunk.

ARCHEGONIA. Plural form of archegonium.

ARCHEGONIUM. Structure in which eggs are produced.

AREA. Region covered by this work and specified in the Introduction.

AREOLAE. Plural form of areolus which is a small, diminutive, clearly marked but irregular, and angular space, bounded by the veins of the fronds.

ARTICULATE. Separating readily at the joint; having the appearance of being jointed; united with a conspicuous joint.

ASCENDING. Growing upwards at an oblique angle.

ASEXUALLY. Without the help of gametes.

ATTENUATE. Gradually diminishing in breadth to a long narrow tapering point.

AURICLE. Appendage or lobe resembling the shape of the lobe of the human ear.

AURICULATE. With two small auricles at the base.

AXES. Plural form of axis.

AXIAL. Pertaining to axis; arising by elongation of the axis.

AXIL. Upper or inner angle between the axis and the frond at the node, or between the rachis-branch and the segment.

AXIS. Main part around which other organs develop (eg., the stem of a plant).

BARBED. With a rigid back-turned point as in a fish-hook.

BASAL. Pertaining to, or near, the base.

BASE. Place of origin (of an organ in a plant).

BASIPETAL. Arrangement in which the youngest structures of a developing axis are present at the base, and the oldest structures at the apex.

BASIPETALLY. As in a basipetal arrangement.

BASISCOPIC. The side of the lamina of a segment, which is towards the base of the frond, and which is bounded by the midrib and the margin.

BICORNATE. Having two processes which resemble horns.

BIFID. More or less cleft into two parts.

BILATERAL. Having two sides, one on either side a central axis; having two surfaces (like a hemisphere with one flat and one curved surface).

BILAYERED. Consisting of two layers.

BILOBATE. Having two lobes; lobed twice.

BIPINNATE. Twice pinnate (pinnate with the primary divisions again pinnate).

BIPINNATIFID. Twice pinnatifid (pinnatifid with the primary divisions again pinnatifid).

BIPLANATE. Having two flat surfaces or planes.

BISERIATE. Arranged in two rows.

BORDERED. Having a border.

BRACTIFORM. Of the shape of a modified leaf below a flower.

BRANCH. Production of one or more lateral processes of the same kind by a central organ, without impeding its own growth or obliterating its own identity; a lateral process so produced.

BRANCHED. Having branches.

BRANCH-GAP. Interruption in the vascular tissue of the axis at the point where the vascular system of a branch arises.

BRITTLE. Neither tough nor tenacious, but breaking when bent.

BUD. Compressed embryonic shoot.

CADUCOUS. Falling off early.

CAESPITOSE. Growing in clusters.

CARBONIFEROUS PERIOD. Period of 230 to 250 million years ago.

CASTANEOUS. Chestnut-coloured.

CELL. Unit of structure of plants and animals, enclosing in it the living protoplasm and being surrounded by a membrane (in the case of plants).

CELL-SAP. Liquid in the vacuoles of plant cells.

CHARACTER. Distinctive features or peculiarities.

CHLOROPHYLL. Green colouring pigment of most plants, which aids in photosynthesis.

CHLOROPHYLLOUS. Containing chlorophyll.

CIRCINATE. Coiled at the tip (like the trunk of an elephant) in the early stages of development (of a frond).

CLASS. Taxonomic category or group of related orders (sometimes only of a single order) and ranking between an order and a phylum in the classification of living things.

CLATHRATE. Latticed or pierced with appertures; having cells, the border cell-walls of which are thickened, so as to give the appearance of a lattice-work.

CLAVATE. Club-shaped.

CLUSTERED. So arranged as to form a close bunch.

COENOSORI. Plural form of coenosorus.

COENOSORUS. Adjacent sori in close contact with each other and forming a long continuous single sorus.

COHERENT. Sticking together.

COMMISSURE. Surface along which two or more internal cavities are joined to each other.

COMPACT. Closely arranged.

COMPITAL. Situated on branching or fusing point of veins.

COMPLETE. Without interruption or break (applied to annulus).

CONCOLOROUS. Having or consisting of one and the same colour.

CONE. Specialized and close aggregation of modified laminae with sporangia, arranged around a central axis.

CONFLUENT. Running into each other; getting mixed up.

CONNATE. In intimate merger with another organ of the same kind, or of its part.

CONNATION. State of being connate.

CONTIGUOUS. In contact with one another.

COPIOUSLY. Abundantly.

CORDATE. Heart-shaped, with a narrow apex and two round lobes at the base.

CORIACEOUS. Leathery (in texture).

CORNATE. Having a process which resembles a horn.

CORRUGATED. Having many small folds.

COSTA. The chief or main nerve or vascular strand in the lamina.

COSTAE. Plural form of costa.

COSTAL. Pertaining to costa; close to the costa.

COSTATE. Having a longitudinal rib.

COSTULE. Prominent branch nerve or vascular strand proceeding from the costa.

CREEPING. Running horizontally and rooting at the nodes.

CRENATE. Cut into rounded or convex teeth.

CRISPED. Forming little curls.

CRUCIFORM. Cross-shaped.

CUNEATE. Wedge-shaped; inversely triangular with rounded corners, one of the corners forming the base.

CUTINISATION. Formation of a cuticle which contains a waxy substance called cutin, and which is impermeable to water.

DECIDUOUS. Shedding at the end of each growing season.

DECURRENT. Extending beyond the insertion and appearing to run downward on the supporting organ; narrowing gradually at the base.

DEFLEXED. Turned abruptly downwards; suddenly bent downwards.

DEHISCE. Split open at maturity.

DEHISCENCE. Process of splitting open at maturity.

DELTOID. Shaped like an equilateral triangle, the attachment being at the middle of one side; triangular in transverse section.

DELTOID-LANCEOLATE. Deltoid, but four to six times longer than the base and with a tapering apex.

DENDRITIC. Tree-like.

DENTATE. Having concave edges and sharp angular teeth projecting laterally.

DIARCH. Having two xylem masses.

DICHOPODIAL BRANCHING. Dichotomous branching in which the branches are unequally developed.

DICHOTOMOUSLY DIVIDING. Dividing always into two.

DICHOTOMY. Phenomenon of dividing dichotomously.

DICTYOSORI. Polypodioid sori which are compital on a plexus of veins.

DICTYOSTELE. A solenostele which is cut up into a ring of separate or scattered vascular strands by the overlapping leaf-gaps or branch-gaps, the pith and cortex joining each other through such gaps, and the xylem in each vascular strand being surrounded completely by phloem.

DICTYOSTELIC. Having a dictyostele.

DIGITATE. With several similar structures like the fingers of a human hand, arising from a common point.

DIGITATELY DIVIDED. Divided in a digitate manner.

DIMIDIATE. Unequal, with only one half or one side developed perfectly.

DIMORPHOUS. Having two forms.

DIOECIOUS. Having male and female cells in separate individuals or organs; having microspores and megaspores in separate individuals or organs.

DIPLODESMIC. Having a secondary vascular system below the receptacle and parallel to the normal venation.

DIPLOID. Having double chromosome number which is characteristic of the sporophyte generation in the life-history of plants.

DISTAL. Away from the base or place of origin.

DISTANT. Far apart.

DISTICHOUS. In two series, one opposite the other.

DIVIDE. Ending in two or more processes of the same kind, so as to lose not only the further growth but also the identity of the organ so ending.

DIVIDED. Having divisions.

DIVISION. The highest taxonomic category made up of closely-related classes of plants; one of the two or more processes in which an organ ends, losing its own further growth and identity.

DORMANT. With reduced physiological activity.

DORSAL. Outer surface of an organ; on the side away from the axis; that which grows on such outer surface of a frond.

DORSIVENTRAL. With a clear differentiation of back and front, or upper and lower, sides.

DOWNY. Densely covered with very short, weak, fine and soft hairs of no specialized type.

DRYMOGLOSSOID. Arranged in a series which runs parallel to the midrib (applicable only to sori).

EBENOUS. Like a finely-polished dark wood.

ECTOPHLOIC. Having phloem only on the outer side.

EGG. Female gamete.

ELLIPSOID. A three-dimensional body with an elliptical outline.

ELLIPTICAL. Like a two-dimensional figure which is one-and-half times as long as broad and not rounded at the ends, the widest part being at the middle.

ELONGATE. Long.

EMBRYO. Rudimentary sporophytic plant formed by the union of the sex cells within an archegonium or an ovule, till it begins its rapid growth.

ENDARCH. With the first-formed xylem elements arising near the inner side of the procambial strands.

ENTIRE. Neither toothed (dentate) nor divided nor lobed (lobate).

EPIDERMAL. Pertaining to epidermis.

EPIDERMIS. Surface layer of cells in an organ.

EPIGAEUS. Growing close upon the earth.

EPIPHYTIC. Growing upon other plants without depending upon them for food.

EQUATORIAL. Midway between the polar extremities; around the middle of a sporangium and in a plane at right angle to the sporangiophore.

ERECT. Growing upright; pointing upwards.

ET. And.

EVANESCENT. Vanishing; disappearing within the margin.

EVENLY. Smoothly; equally.

EX. Coming from the authority of; formerly.

EXARCH. With the first-formed xylem elements arising on the outer side of the procambial strands.

EXINDUSIATE. Without an indusium.

EXPECTORANT. A medicine which promotes expulsion as phlegm, by coughing.

EXTANT. Available as living specimens.

EXTERNAL APPLICATION. That which is applied externally on wounds, etc.

EXTINCT. No longer available as living specimens.

EXTROSE. Facing outwards and towards the margin, and turned away from the appertaining base or axis.

FAMILY. Taxonomic category consisting of a group of related genera (sometimes of a single genus) and ranking between genera and an order, in the classification of living things.

FARINA. A powdery substance.

FARINOSE. Mealy; having a powdery substance or farina.

FERN. Green plant which passes through an embryo-stage in its life-history, and which has a heterogenous and inconspicuous gametophytic generation alternating with an elaborately-developed sporophytic generation that has cuticle on the aerial parts, complex vascular strands with branch-gaps and leaf-gaps, true roots,

much-reduced stems, and elaborately-developed fronds which bear on the dorsal surface, multicellular sporangia with one or more layers of sterile cells.

FERTILE. Productive of fruits or spores; opposite of sterile.

FERTILIZE. Render fertile; unite with female gamete and effect its further development.

FIBROUS. With several major organs of about the same length and arising from almost the same point.

FILAMENTOUS. Composed of thread-like row of cells.

FILIFORM. Threadlike; long, slender and cylindrical.

FLAT. Pressed vertically down; having an even surface.

FLEXUOSE. Curved first in one direction and then in opposite direction.

FLOAT. Rest on the surface of water; a device which helps to remain on the surface of water.

FOLIOSE. Flat and leaf-like.

FORKING. Dividing into two.

FORMATION. A large natural assemblage of plants, growing together over a wide region.

FOSSIL. Impression or trace of former existence of life, in the earth's crust.

FREE. Separate from other organs; not anastomosing; not attached.

FRINGED. Having a margin which is bordered by processes thicker than hairs.

FROND. Leaf of a fern.

FUGACEOUS. Falling off very early.

FURCATE. Ending in two long and nearly equal branches.

FUSE. Become mixed up with other organs of the same kind.

GAMETE. Sex cell.

GAMETOPHYTE. Sexual (or gamete-producing) generation, characterized by the haploid chromosome number in the alternation of generations.

GAMETOPHYTIC. Pertaining to gametophyte.

GELATINIZE. To develop the consistency of jelly.

GELATINOUS. Having the consistency of jelly.

GENERA. Plural form of genus.

GENUS. Group of closely-related species.

GERMICIDAL. Capable of killing bacteria and other micro-organisms.

GLABROUS. Without any hair or scale.

GLANDULAR. Having glands.

GLAUCOUS. Covered with a white or bluish powder (or bloom) which is made up of finely-divided particles of wax.

GLOBOSE. Spheroidal; nearly spherical.

GLOBOSE-PYRIFORM. Globose, but a little elongated or pear-shaped.

GLOBOSE-TETRAHEDRAL. Globose, but also having four indistinct sides and three small ridges, the latter radiating from a common point.

GRADATE. Having sporangia in basipetal arrangement on the receptacle.

GRANULAR. Of the size of grains; like grains.

GRANULOSE. Covered by minute hard granules.

GROOVE. A longitudinal depression.

GROOVED. Having one or more longitudinal depressions.

HABIT. General appearance of a plant or of its specified part.

HAIR. Slender thin projection consisting of cells usually arranged end to end.

HAIRY. With a covering of hairs.

HAPLOID. Having single chromosome number which is characteristic of the gametophyte generation in the life-history of plants.

HASTATE. Having a pair of acute, diverging lobes at the base, which stand out nearly at right angles.

HERB. A non-woody annual.

HERBACEOUS. Of soft, green and thin texture, with minimum of woody tissue.

HERBARIA. Plural form of herbarium.

HERBARIUM. A systematically-arranged collection of pressed, dried and named plants.

HERBARIUM SHEET. Smooth, thick, stiff, white, cartridge paper, measuring about 45·5 cm. x 30·5 cm., and weighing 28 lbs. per ream of 480 flat sheets, and used for mounting specimens in a herbarium.

HETEROGAMOUS. Producing two kinds of gametes which differ in size, structure and behaviour.

HETEROSPORANGIATE. Having sporangia of more than one type.

HETEROSPOROUS. Producing spores of more than one type.

HEXAGONAL. Six-sided.

HOMOSPOROUS. Producing spores of a single type.

HORN. Hard projection from sporocarp, etc.

HYALINE. Thin, soft, pliable, colourless and transparent.

HYDROPHYTE. Plant which lives in water, or on very wet soils.

HYDROPHYTIC. Growing in water, or on very wet soils.

IMBRICATE. Partly overlapping and partly overlapped, like the shingles on a roof.

INCISSED. Deeply cut into narrow and angular portions.

INCLUDED VEINLET. A veinlet that does not protrude beyond the normal veins surrounding it.

INCOMPLETE. Having one or more interruptions.

INCURVED. Curved inwards.

INDEFINITE. Not having a definite shape; growth not ceasing.

INDEHISCENT. Not opening along regular seams; not opening at all.

INDUSIAL. Pertaining to indusium.

INDUSIATE. Having an indusium.

INDUSIUM. Membrane-like covering of a fern-sorus.

INTERNODE. The part of axis between two successive points of origin (of leaves, buds, etc.).

INTERRUPTED. Without continuity; a uniform arrangement with breaks in uniformity here and there.

INTERSTITIAL. Pertaining to narrow space between closely-arranged cells, tissues, etc.

INTROSE. Facing inwards and away from the margin; turned towards the base or axis appertaining to it.

IRIDESCENT. Shimmering with rain-bow colours.

JOINTED. Having conspicuous joints.

JURASSIC PERIOD. Period of 135 to 165 million years ago.

JUVENILE FROND. Young frond appearing at the beginning of growth of a young fern, and differing from the later-produced fronds.

KEY. An artificial arrangement of characters for identification of the collections from a given area.

LAMINA. Flat expanded portion of a frond or of its divisions.

LAMINAE. Plural form of lamina.

LANCEOLATE. Shaped like a lance-head, tapering at both ends, and four to six times as long as broad.

LANCEOLATE-OVATE. Lanceolate, but with an obtuse (instead of acute) apex.

LATERAL. At the side or along the margin.

LAX. Soft, loose.

LEAF-GAP. Interruption in the vascular system of the axis at the point from where that system branches off and proceeds to the leaf or frond.

LEAFLET. A leaf-like organ which is smaller, both in status and in size, than the leaf or frond.

LIFE-HISTORY. Cyclic series of biological activities involving a vegetative phase of growth, a phase of reproductive function, and a phase of rest and resistance to unfavourable environment.

LINEAR. Narrow, with parallel sides, the length being eight or more times longer than the width.

LINEAR-DELTOID. Linear, but with a straight basal edge running at right angle to the stalk, to which it is connected at the middle.

LINEAR-ELONGATE. Linear, but the margins not quite parallel (grass-blade-like).

LINEAR-LANCEOLATE. Linear, but tapering at both ends.

LINEAR-OBLONG. Linear, but only two or three times longer than broad and obtuse at both ends.

LITHOPHYTIC. Growing on rocky or very dry soils.

LOBATE. Partly divided into a definite number of short, flat portions by the shallow indentation of the lamina.

LOBE. Short, flat portion formed by the shallow indentation of the lamina, or by the extension of the margin.

LONGITUDINAL. Parallel, or almost so, to the direction of the growth of the stalk, pedicel, stipe or midrib as the case may be.

MARGIN. The outer edge of a lamina.

MARGINAL. Pertaining to margin; arising from, or attached to, margin.

MASSULA. Mass of microspores joined together in a hardening mucilage.

MASSULAE. Plural form of massula.

MEGAPROTHALLI. Plural form of megaprothallus which is a female prothallus resulting from the growth of a megaspore and producing only archegonia.

MEGASPORANGIA. Plural form of megasporangium.

MEGASPORANGIAL. Pertaining to megasporangium.

MEGASPORANGIUM. Sporangium in which megaspores are produced.

MEGASPORE. The larger of the two types of spores produced by a plant and developing into a megaprothallus.

MEGASPOROCARP. Sporocarp containing only megasporangia.

MEMBRANACEOUS. Thin, soft, pliable and translucent.

MERISTELE. The branch of a (main) stele, which leads on to the leaf.

MICROPROTHALLI. Plural form of microprothallus which is a male prothallus resulting from the growth of a microspore and producing only antheridia.

MICROSPORANGIA. Plural form of microsporangium.

MICROSPORANGIUM. Sporangium which produces microspores.

MICROSPORE. The smaller of the two types of spores produced by a plant, and developing into a microprothallus.

MICROSPOROCARP. Sporocarp containing only microsporangia.

MIDRIB. Middle vein of a leaf or other similar structure.

MIXED. Having sporangia of different ages irregularly without any sequence of age on a receptacle (applicable to sorus).

MONOECIOUS. Having the male and the female cells in one and the same individual or organ; having the microspores and the megaspores in one and the same individual or organ.

MONOGENERIC. Consisting of only a single genus.

MONOPODIAL. Having a single main axis which continues to grow along the original line of growth, and which gives off lateral branches such that the youngest branches are at the apex and the oldest at the base.

MONOSTICHOUS. Arranged in only one vertical series or ranks.

MUCILAGE. Heavy substance which is formed inside the plant body but not exuded out, and which is closely allied to gums and pectins, and which forms slippery, colloidal and optically-active solutions in water.

MUCILAGINOUS. Pertaining to mucilage; slimy, as if covered with mucilage.

MUCILAGINOUS CANAL. Duct or vessel for the movement of mucilage (within the plant body).

MUCRONATE. Abruptly terminating in a hard short point.

MULTICELLULAR. Many-celled.

MULTICILIATE. Having a number of hair-like protoplasmic processes.

MULTIPINNATE. Several times pinnate (pinnate, the divisions again pinnate, and so on).

MULTISEPTATE. Having many partitions or cross-walls.

MULTISERIATE. Arranged in several rows.

MULTISPORANGIATE. Having many sporangia (applicable to sori).

MYCORRHIZA. Symbiotic association of roots with a fungus.

NODE. A point on the axis, from which a leaf arises.

NON-ARTICULATE. Not articulate.

NON-CLATHRATE. Not clathrate.

NON-PARAPHYSATE. Not paraphysate.

NORMAL. Of regular specifications or pattern.

NOTCHED. Incissed or indented.

NUMEROUS. Several; not of a definite number.

OBCORDATE. Heart-shaped, but inverted.

OBLIQUE. Having slightly unequal sides; slanting at an angle, but not right angle, to the direction of growth.

OBLIQUE-ELONGATE. Long and slanting at an angle.

OBLONG. Much longer than broad with nearly parallel sides, and obtuse at both ends, the length being about twice or thrice the breadth.

OBLONG-LANCEOLATE. Oblong, but tapering at both ends.

OBLONG-LINEAR. Oblong, but narrow.

OBLONG-OBOVATE. Oblong, but obtuse at both ends, the basal end being smaller than the distal.

OBLONG-OVATE. Oblong, but obtuse at both ends, the basal end being larger than the distal.

OBLONG-OVOID. Three-dimensional object with an oblong-ovate outline in a sectional view.

OBOVATE. With an outline like that of an egg, the narrow part being towards the base or attachment.

OBOVOID. Three-dimensional figure with an ovate outline in longitudinal section, and with the narrow part towards the attachment.

OBTUSE. Blunt or rounded at the end.

OPEN. Not anastomosing (veins).

OPPOSITE. Placed at the same level, and in the same plane, and on the opposite sides of the supporting axis; placed opposite to each other.

ORBICULAR. Perfectly circular in outline.

ORDER. Taxonomic category consisting of a group of related families (sometimes of only a single family), and ranking between a family and a class, in the classification of living things.

OVATE. With an outline like that of an egg, the broad part being towards the base or attachment.

OVATO-CORDATE. Ovate, but with a narrow apex and two round lobes at the base.

OVOID. Three-dimensional figure with an ovate outline in longitudinal section, and with the narrow part away from the attachment.

PALEACEOUS. Covered with small, weak, erect and membranaceous scales.

PALMATE. Lobate and appearing like a lady's hand-fan; divided so that the segments radiate from a common point, like the fingers of a hand; originating at an almost common point at the base and radiating outwards.

PAPILLAE. Minute, rounded and rather soft projections of unequal size.

PAPILLOSE. Having minute, rounded, rather soft projections of unequal size.

PARALLEL VENATION. Venation in which the principal veins are parallel, or nearly so, to one another, and usually remain close together.

PARAPHYSATE. Having paraphyses.

PARAPHYSES. Plural form of paraphysis.

PARAPHYSIS. Sterile filament associated usually with sporangia and gametangia.

PARASITE. Dependent on another living organism for existence.

PARASITIC. Like a parasite.

PARENCHYMA. Tissue of thin-walled (and often iso-diametric) cells, often performing storage of food and other functions, and usually retaining meristematic potentialities.

PARTITE. Divided into a definite number of segments which extend nearly to the base.

PEDICEL. The delicate stalk of an individual organ in a cluster of similar organs.

PEDICELLATE. Having a pedicel.

PELTATE. Attached to the stalk by the lower surface instead of at a point on the margin.

PENDULOUS. Hanging downwards owing to weight.

PERENNIAL. Living for several (generally more than two) years.

PERISPORE. Remains of the spore-mother cell, which persist as a covering on the outer wall of a spore, helping it float in the air, or getting changed into narrow flaps or spines.

PERSISTENT. Not falling off for a long time.

PHLOEM. Complex conducting tissue in plants, which usually carries manufactured food or organic materials to places of use or storage.

PHOTOSYNTHETIC. Capable of preparing starch with carbon dioxide and water in the presence of sunlight.

PINNA. Primary division (leaf-like or otherwise) of a pinnately compound leaf or frond.

PINNAE. Plural form of pinna.

PINNA-MARGIN. Margin of pinna.

PINNA-STALK. Stalk of pinna.

PINNATE. Divided or branched feather-like, the divisions or branches being arranged right and left along an axis.

PINNATELY. In a pinnate manner.

PINNATIFID. Incissed pinnately and deeply, the lobes being not quite separate from one another and extending not beyond half-way to the axis or rachis.

PINNATIPARTITE. Incissed pinnately and deeply, the lobes being not quite separate from one another and extending beyond the middle without interrupting the parenchyma.

PINNULAR. Pertaining to pinnule; like a pinnule.

PINNULE. Secondary division (leaf-like or otherwise) of a twice or more-pinnately divided leaf or frond.

PINNULE-STALK. Stalk of a pinnule.

PIONEERING. Preparing a way for other plants.

PITTED. Having numerous small shallow depressions.

PLEOSORI. Polypodioid sori which are compital on anastomosing veins.

POLAR. Pertaining to diametrically opposite points on a sphere; arising from, or connected with, such points.

POLYPINNATE. Many times pinnate (ie., pinnate with the primary, secondary, tertiary, quarternary, and other divisions or branches being again pinnate).

POLYPODIOID SORI. Globose or oblong sori.

PORE. Any small apperture, generally circular, for the escape of contents in an organ.

PORTFOLIO. Receptacle in the form of a large book-cover containing loose sheets of absorbent paper, kept closely pressed with straps and ropes.

POULTICE. Soft composition which is applied on sores.

PRIMARY BRANCH. First unit of branching.

PRIMARY ROOT. First-formed root emerging from the embryo,

PRIMITIVE. Relatively old, as revealed by evolutionary studies.

PROLIFIC. Fruitful or productive.

PROFUSE. Several; numerous; not of any definite number.

PROSTRATE. Lying flat on the ground.

PROTHALLI. Plural form of prothallus.

PROTHALLUS. Gametophyte of ferns and other similar plants.

PROTOSTELE. Stele with a central solid core of xylem with a surrounding phloem, but without pith.

PROTOSTELIC. Having a protostele.

PROXIMAL. Near, or towards, the base or place of origin.

PSEUDO-ACROSTICHOID. Apparently acrostichoid but not so in reality.

PSEUDO-DICHOTOMY. Phenomenon of branching dichotomously only apparently but not in reality.

PSEUDO-INDUSIA. Plural form of pseudo-indusium.

PSEUDO-INDUSIUM. That which functions like the indusium but does not arise like the indusium.

PSEUDO-SPORE. That which is like a spore but not the spore itself; spore-like but not germinating.

PSEUDO-TRIPINNATE. Apparently tripinnate but not so in reality.

PUBESCENT. Same as downy; finely and softly hairy, the hairs being of no specialized type.

PUNCTIFORM. Shaped like a dot; round like a dot.

PYRIFORM. Pear-shaped.

QUADRANGULAR. Four-angled.

QUADRILOBATE. Having four lobes; lobed four times.

QUADRIPINNATE. Four times pinnate.

RACHIFORM. Rachis-like.

RACHIS. Extension of the stipe, which serves as the central axis of a pinnate frond.

RADIAL SYMMETRY. Capable of division into three or more similar sections passing through almost the same point in the axis; with parts arranged circularly around the axis.

RADIAL VENATION. Venation in which the veins radiate in divergent directions from almost a common point; veins radiating from the base.

RADIATING. Proceeding in several directions from almost a common point.

RAISED. Lying prominently as if protruding out of the surface.

RAPHE. Connecting attachment at the tip of the pedicel and the base of the sporocarp or the other like organ, in the form of a ridge.

RECEPTACLE. Part from which the sporangia arise and on which they are borne.

RECURRENT VEIN. Vein that returns towards the middle of the lamina from the margin; vein that runs backwards.

REFLEXED. Suddenly bent or directed backwards.

RETICULATE. In the form of a network.

RHIZOME. Generally underground axis, producing roots below and leaves above, and either horizontal or ascending at an angle.

RIB. Strong vein.

RIBBED. Having strong veins.

ROOT-CAP. A thimble-like organ covering the growing tip of a root.

ROSETTE. A circular cluster.

ROTUND. Rounded in section.

RUDIMENTARY. Imperfectly developed; vestigeal.

SAGITATE. Shaped like an arrow-head, with two straight lobes prolonged at the base and directed towards the stalk.

SAPROPHYTIC. Depending upon dead and decaying organic matter for existence.

SCALE. Very thin, minute, membranaceous, flat, dry, non-green structure fixed at one end.

SCALY. Having scales.

SCANDENT. Clinging and supporting.

SCARIOSE. Like a translucent scale.

SCATTERED. Placed distantly from each other; distributed here and there in a specified place.

SCLERENCHYMA. Strengthening tissue composed of cells with thick, hard walls.

SECONDARY BRANCH. Second unit of branching.

SEED. A reproductive structure with embryo and food-storage tissue, in flowering plants.

SEGMENT. Ultimate leaf-like unit of a divided frond, pinna, pinnule, etc.

SEMITERETE. Almost rounded without angular projections or edges.

SEPTATE. Having internal partitions.

SERIATE. Arranged in rows.

SERIES. Row or rows.

SERRATE. With sharp and angular teeth pointing towards the apex.

SESSILE. Having no appreciable stalk.

SEXUALLY. Through the production and fusion of gametes of two different kinds.

SEXUAL REPRODUCTION. Reproducing one's own kind through the production and fusion of gametes of two different kinds.

SHEATHE. Protect with a casing.

SHINING. Having an even polished surface.

SHRUBBY. Resembling a woody plant which is smaller than a tree; a vegetation which is composed of such plants.

SIMPLE. Scarcely branching or dividing (when applied to fronds, etc.); consisting of a few larger sporangia of the same age (when applied to sori).

SINUS. Cleft; embayment.

SIPHONOSTELE. Stele with a central pith.

SIPHONOSTELIC. Having a siphonostele.

SLIT. Any small apperture, generally elongated, for the escape of contents in an organ.

SOLENOSTELE. Stele in which there is a central pith, and in which there is a phloem on both the inner and the outer sides of the xylem.

SOLENOSTELIC. Having a solenostele.

SOLITARY. Growing singly.

SORI. Plural form of sorus.

SORIFEROUS. Having or producing sori.

SOROPHORE. Special modified organ which bears the sorus or sori; special lobe bearing the sorus or sori; gelatinized receptacle flowing out with the mucilage and sorus or sori, from sporocarp; that which bears sori.

SORUS. Cluster of sporangia.

SP. Species.

SPARSELY. Thinly; in a scattered manner.

SPECIES. Smallest and relatively stable group of related varieties, all of the same ancestry, and of nearly identical structures, and of capacity to inter-breed freely, in the natural system of classification of living things.

SPERMATOZOIDS. Male gametes.

SPICULAR. Small, sharp and needle-shaped.

SPIKE. Elongating axis, on and along which the sori or sporocarp or sporangia are arranged in a sessile manner, like the sessile flowers of an indeterminate type of inflorescence of the same name (spike).

SPINE. A pointed cone-like projection.

SPINY. Having spines.

SPIRALLY. Like the screw-thread around a common axis.

SPORANGIA. Plural form of sporangium.

SPORANGIAL. Pertaining to sporangium.

SPORANGIOPHORE. Structure that bears one or more sporangia; sporangial stalk.

SPORANGIUM. Spore case; a structure in which spores are produced.

SPORE. Simple, unicellular reproductive structure which is asexually produced in a sporangium and which contains haploid chromosomes.

SPOROCARP. Special, hard, fruit-like structure, containing atleast one sporangium.

SPOROPHYTE. Asexual or spore-producing generation, characterized by the diploid chromosome number in the alternation of generations.

SPOROPHYTIC. Pertaining to sporophyte.

SQUAMIFORM. Like a minute, thin, membranaceous, flat, dry and non-green structure which is fixed at one end.

STALK. Part that bears or supports organs like leaf, flower, fruit, etc.

STALKED. Having a stalk.

STAND. A conspicuous local group or natural assemblage of plants of the same kind.

STELE. A collective name for the vascular and closely-related tissues (like xylem, phloem, pith, pericycle and interfascicular parenchyma) in stems, roots, etc.

STELLATE. Star-shaped; dividing in such a manner that the branches radiate and present the outline of a star (eg., hairs with two or three branches); divided at the base and the divisions spreading outwards.

STERILE. Productive of nothing; opposite of fertile.

STIPE. A supporting stalk which is neither a petiole nor a peduncle; that which connects a frond to the axis of ferns.

STIPITATE. Having a stipe.

STIPULE. A small green and leaf-like appendage at the base of a leaf, in many species of plants.

STOCK. Small, short upright axis of a small non-arborescent fern.

STOLONIFEROUS. With branches growing along the ground and producing adventitious roots.

STOMIUM. Place or point of thin-walled cells on the surface of a sporangium, where the dehiscence takes place.

STRAGGLING. Irregularly turning off, but almost at right angle.

STREAKED. Having streaks.

STRIATED. Having longitudinal lines.

STROBILI. Plural form of strobilus.

STROBILUS. Cone-like collection or assemblage of modified fertile leaves on an axis.

STYPTIC. Substance which stops the flow of blood.

SUBAERIAL. Partly in air and partly in a substratum.

SUBARBORESCENT. Almost or nearly tree-like, but without a distinct trunk.

SUBCLASS. Almost or nearly a taxonomic group of related orders (sometimes only a single order) ranking between an order and a class in the classification of living things.

SUBCORIACEOUS. Almost or nearly leathery in texture.

SUBCOSTAL. Pertaining almost (but not actually) to a prominent nerve or midrib; that which is by the side of a costa.

SUBDELTOID. Shaped almost or nearly like an equilateral triangle, the point of attachment being at the middle of one side.

SUBDIMORPHOUS. Of almost or nearly two forms.

SUBDIVISIONS. A group of related classes ranking between a division and a class in the classification of plants.

SUBEPIDERMAL. Below the epidermis.

SUBGENUS. Almost or nearly a group of closely-related species, or (sometimes) a single species, in the classification of living things.

SUBGLOBOSE. Almost or nearly spheroidal.

SUBMARGINAL. Very near, or close to, the margin.

SUBMERSED. Put under, or covered with, water.

SUBOPPOSITE. Almost or nearly opposite.

SUBSESSILE. Almost or nearly sessile; having a very small and inconspicuous stalk.

SUBSINUATE. Almost or nearly winding or bending to and fro.

SUBSTRATUM. Substance on which an oraganism may live.

SUBTERRANEAN. Remaining below the surface of the earth.

SUBTRIPINNATE. Almost or nearly tripinnate.

SUBULATE. Linear, but tapering to a fine point.

SUCCESSION. Act of things following in a regular order of sequence.

SUCCULENT. Thick and juicy.

SUNK. Embedded.

SUNKEN. Placed below the general surface.

SUPERFICIAL. Belonging to the periphery of an organ.

SUPPRESSED. Arrested in growth.

SYMPODIALLY BRANCHING. Branching always into two, the bases of successive branches being so arranged as to resemble a simple or monopodial axis.

SYNANGIA. Groups formed bv the coalescence of more than one sporangium.

SYN. Synonym (s).

SYNONYM. Name applied later to the same plant or applied earlier to a different plant, and therfore not used now.

SYSTEM. Method of classification of plants; a set of connected things or parts.

TANNIN. A kind of acid in wood cells.

TERETE. Rounded, without angular projections or edges.

TERMINAL. That which is situated at the end of an organ or tissue or branch or division.

TERRESTRIAL. Growing on land.

TETRAHEDRAL. Having four surfaces (three flat and one curved), like a quarter-sphere with three ridges radiating from a common point.

TEXTURE. Thickness, strength, stiffness, etc. as felt by the hand.

THALLOID. Flat; like a simple plant body with very little cellular differentiation into leaves, stems or roots.

THICKET-FORMING. Forming a closely-set collection of plants (chiefly trees or shrubs).

TISSUE. Group of similar cells with a common function.

TOOTH. Projection in the margin of a dentate lamina.

TRANSLUCENT. Allowing limited light to pass through.

TRANSPIRATION. Escape of water in the form of vapour through the stomata from the aerial parts of plants.

TRANSVERSE. At right angles to the longitudinal axis, or to the direction of growth or elongation.

TRANSVERSELY. In a transverse manner.

TRIFOLIATELY LOBATE. Having three lobes.

TRIPARTITE. Thrice divided almost to the axis (or rachis) into a determinate number of divisions.

TRIPINNATE. Thrice pinnate (ie., pinnate, the primary divisions again pinnate, and the secondary divisions also again pinnate).

TRIPLANATE. Having three flat surfaces (or planes).

TRIWALLED. Consisting of three walls.

TRUE FERN. Fern the sporophyte of which produces spores in sporangia which are arranged in sori generally on the dorsal surface of the frond, the spores on liberation germinating on the substratum and forming small heart-shaped gametophyte; and the gametophyte of which bears antheridia and archegonia, the fertilization taking place inside the archegonia while necessarily in water; and the fertilized egg of which develops within the archegonium and later becomes the sporophyte.

TRUE LEAF. Leaf with storage tissues and conducting vessels.

TRUE ROOT. Root with absorbing and storage tissues and conducting vessels.

TRUE STEM. Stem with storage or mechanical tissues and conducting vessels.

TRUE VEIN. Vascular strand proceeding towards the margin of a leaf or frond.

TRUNCATE. Ending abruptly as though cut off.

TUBEROUS. Resembling in appearance or character, a thick and short underground stem.

TWINING. Twisting round another object for support and growing upward.

ULTIMATE. Final; the last unit of branching or division.

UNDERGROUND. Below the soil-surface.

UNDIVIDED. Not cut into smaller units.

UNDULATE. Forming an irregular or wavy lines.

UNEQUILATERAL. Having unequal sides.

UNILATERAL. Having a single side.

UNIMORPHOUS. Having one form only.

UNISERIATE. Arranged in a single row.

UNISPORANGIATE. Having only a single sporangium.

VAR. Variety.

VARIETY. A group of related organisms of the same, or almost the same, ancestry, differing from each other only in minor details, and forming a sub-division of a species in the natural system of classification of living things.

VASCULAR COMMISSURE. Surface along which the internal cavities of two or more conducting vessels are joined together in a frond.

VASCULAR STRAND. Thread-like fibre of conducting and strengthening tissues (xylem and phloem) in a plant organ.

VASCULAR SYSTEM. Tissue of conducting vessels.

VEGETATING. Absorbing raw materials, synthesising and translocating foods and other organic substances, consuming them (foods), and growing but not reproducing (itself).

VEGETATIVE BUD. Embryonic shoot concerned with the growth of the plant body, but not with the sexual reproduction.

VEGETATIVELY. Otherwise than by sexual reproduction.

VEIN. Nerve or vascular strand branching and proceeding from the costule of a frond.

VEIN-END. Terminal part of a vein.

VEINLESS. Without a vein.

VEINLET. Final unit of branching of veins in a leaf or frond.

VENATION. Arrangement of nerves or vascular strands in a leaf or frond.

VENTILATION. Replacement of used-up air by fresh air.

VENTRAL. On that side of the lamina, which is towards the axis; upper side of a frond.

VENULE. Nerve or vascular strand in a leaf or frond, not distinct as costa, costule, vein, or veinlet.

VERNATION. Arrangement of leaves or development of a single leaf, in the bud stage.

VILLOUS. With long and soft hairs which are interlacing.

WALL. Tissue which forms the outer protective layer for an organ.

WARTY. Overgrown with hard dry growth on the exterior; that which is similar to *that* condition.

WAXY. Having the texture and colour of wax.

WEED. Herb or shrub growing wild and rank in a place where it is not wanted.

WING. Expansion bordering or surrounding an organ.

WIRY. Like a wire ; lean and sinewy.

WOODY. Having the texture of wood.

WOOLLY. Densely covered with long, rigid, and matted hairs which are not straight.

XEROPHYTE. Plant which grows in soils with scanty water-supply, or under very dry conditions.

XEROPHYTIC. Growing on soils with scanty water-supply, or under very dry conditions.

XYLEM. Complex conducting tissue in plants, which usually carries nutrient water, minerals and some stored food from the roots to the leaves.

ZYGOTE. A diploid cell formed by the fusion of two haploid gametes.

APPENDIX IV

ABBREVIATION OF AUTHORS' NAMES

(Attached to Plant Names)

Bedd. — R. H. Beddome
Bernh. — J. J. Bernhardi
Bl. — C. L. Blume
Bonpl. — A. Bonpland
Bory. — Bory de Saint-Vincent
Brack. — Brackenridge
Brongn. — A. T. Brongniart
Burm. — J. Burmann
Burm. f. — N. L. Burmann (son)
Cav. — A. J. Cavanilles
C. Chr. — C. Christensen
Ces. — V. Cesati
Ching — R. C. Ching
Clarke — C. B. Clarke
Don — D. Don
Dryand. — J. Dryander
Endl. — S. L. Endlicher
Fee — A. L. A. Fee
Forsk. — P. Forskal
Forst. — G. Forster
Gaud. — C. Gaudichaud-Beaupre
Grev. — R. K. Greville
Haml. — Hamilton
Hassk. — J. K. Hasskarl
Heyn. — B. Heyne
Hk. — W. J. Hooker
Hoffm. — G. F. Hoffmann
Humb. — A. von Humboldt
J. Sm. — John Smith
Juss. — A. L. Jussieu
Kl. — J. F. Klotzsch
Klf. — G. F. Kaulfuss
Koen. — J. G. Koenig
Kolhat. — G. G. Kolhatkar
Kze. — G. Kunze
L. — Linnaeus (C. von Linne)
Lab. — de Labillardiere
Lamk. — J. B. A. P. Monet de Lamarck
L. f. — C. Linnaeus (son)
Link — H. F. Link
Linn. — Linnaea
Lowe — E. J. Lowe
Luerss. — C. Luerssen
Mart. — C. F. P. Martius
Mchx. — A. Michaux
Mett. — G. H. Mettenius
Meyr. — A. Meyer
Mirb. — Mirbel
Moore — T. Moore
Mull. — F. von Muller
Neck. — N. J. de Necker
Poir. — J. L. M. Poiret
Pr. — C. B. Presl
Raf. — C. S. Rafinesque-Schmaltz
R. Br. — R. Brown
Reinw. — C. G. C. Reinwardt
Retz. — A. J. Retzius
Rich. — L. Richard
Roem. — J. J. Roemer
Roxb. — W. Roxburgh
Rumph. — G. E. Rumphius
Schott — H. Schott
Schrad. — H. A. Schrader
Sm. — J. E. Smith
Spr. — C. K. Sprengel
Sw. — O. Swartz
Thouars — Aubert du Petit-Thouars
Thunb. — C. P. Thunberg
Underw. — L. M. Uunderwood
Vahl — M. Vahl
Wall. — N. Wallich
Webb — G. Webb
Webb *et* Bert. — P. B. Webb *et* Berthelot
Willd. — K. L. Willdenow

APPENDIX V

TAMIL NAMES OF FERNS

(Vide Introduction)

BOTANICAL NAME	*TAMIL NAME*	*PAGE*
Actiniopteris radiata	ஆக்டினியாப்டெரிஸ் ரேடியாடா [விசிறி பெரணி]	21
Adiantum caudatum	ஏடியான்டம் காடாட்டம் [பரவும் பெரணி]	28
Angiopteris evecta	ஆங்கியாப்டெரிஸ் எவெக்டா [படகுப் பெரணி]	16
Azolla pinnata	அஜோல்லா பின்னாடா [கொசுப் பெரணி]	43
Blechnum orientale	பிலேக்னம் ஓரியென்டேல் [கெட்டிப் பெரணி]	36
Cheilanthes farinosa	சீலாந்தெஸ் பாரினோஸா [வெள்ளிப் பெரணி]	25
,, mysurensis	சீலாந்தெஸ் மைஸூரென்ஸிஸ் [மைஸூர் உதடுப் பெரணி]	23
,, tenuifolia	சீலாந்தெஸ் டென்யூயிபோலியா [மெல் இதழ் பெரணி]	24
Dicranopteris linearis	டைக்ரனாப்டெரிஸ் லீனியாரிஸ் [இரும்புப் பெரணி]	33
,, linearis var. linearis	டைக்ரனாப்டெரிஸ் லீனியாரிஸ் - லீனியாரிஸ் [நீள இரும்புப் பெரணி]	34
Hemionitis arifolia	ஹெமியோனைடிஸ் ஏரிபோலியா [கோவேறு கழுதைப் பெரணி]	26
Lindsaea ensifolia	லிண்ட்ஸேயா என்ஸிபோலியா [ஈட்டிப் பெரணி]	31
Lygodium scandens	லைகோடியம் ஸ்காண்டென்ஸ் [வளையும் பெரணி]	19
Marsilea coromandelica	மார்ஸிலியா கோரோமாண்டலிகா [சோழமண்டல ஆராக்கீரை]	41
Marsilea minuta	மார்ஸிலியா மைன்யூடா [சிற்றாராக் கீரை]	40
Ophioglossum nudicaule	ஓபியோக்லாஸம் நூடிக்கால் [விறியன் நாக்குப் பெரணி]	15
Pleopeltis linearis	பிலியோபெல்டிஸ் லீனியாரிஸ் [பலக்கால் பெரணி]	38
Vittaria elongata	விட்டேரியா இலாங்காட்டா [புல் பெரணி]	29

Index of Plant Names

(*Genera and species in bold characters; synonyms in Italics*)

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PLATES

The scales of magnification or reduction, as the case may be, are indicated as near the concerned figure as possible. Their absence should be taken to interpret that the magnification is over 100 times.

PLATE I

Ophioglossum nudicaule L. f.

A. Whole plant.

B. Sterile pinna.

C. Fertile pinna.

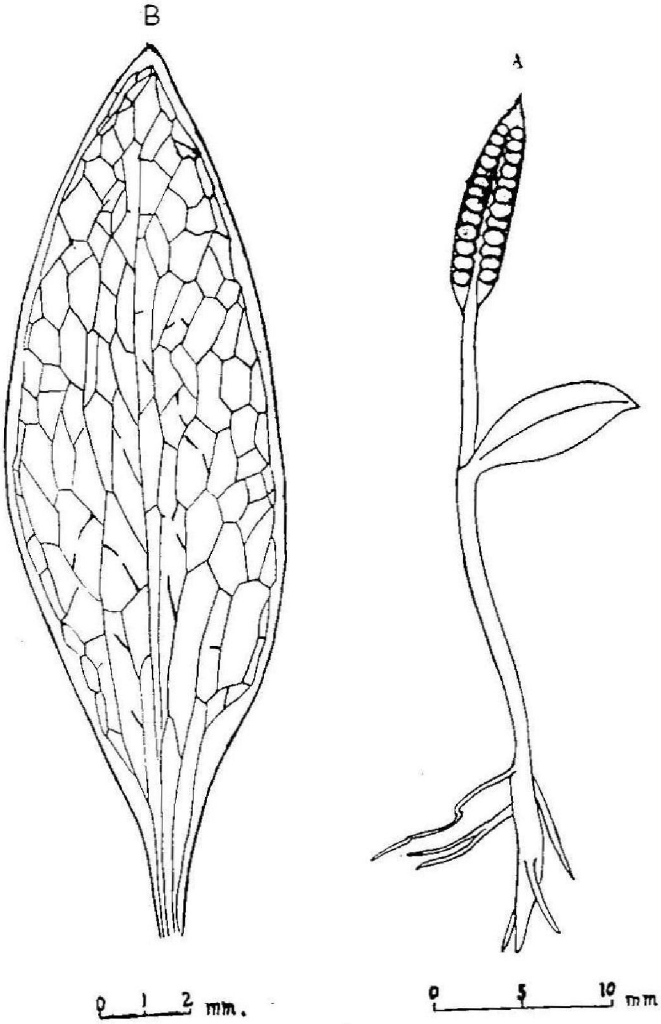

B
A
C
0 1 2 mm.
0 5 10 mm.
0 1 2 mm.

PLATE II

Angiopteris evecta (Forst.) Hoffm.

Part of frond.

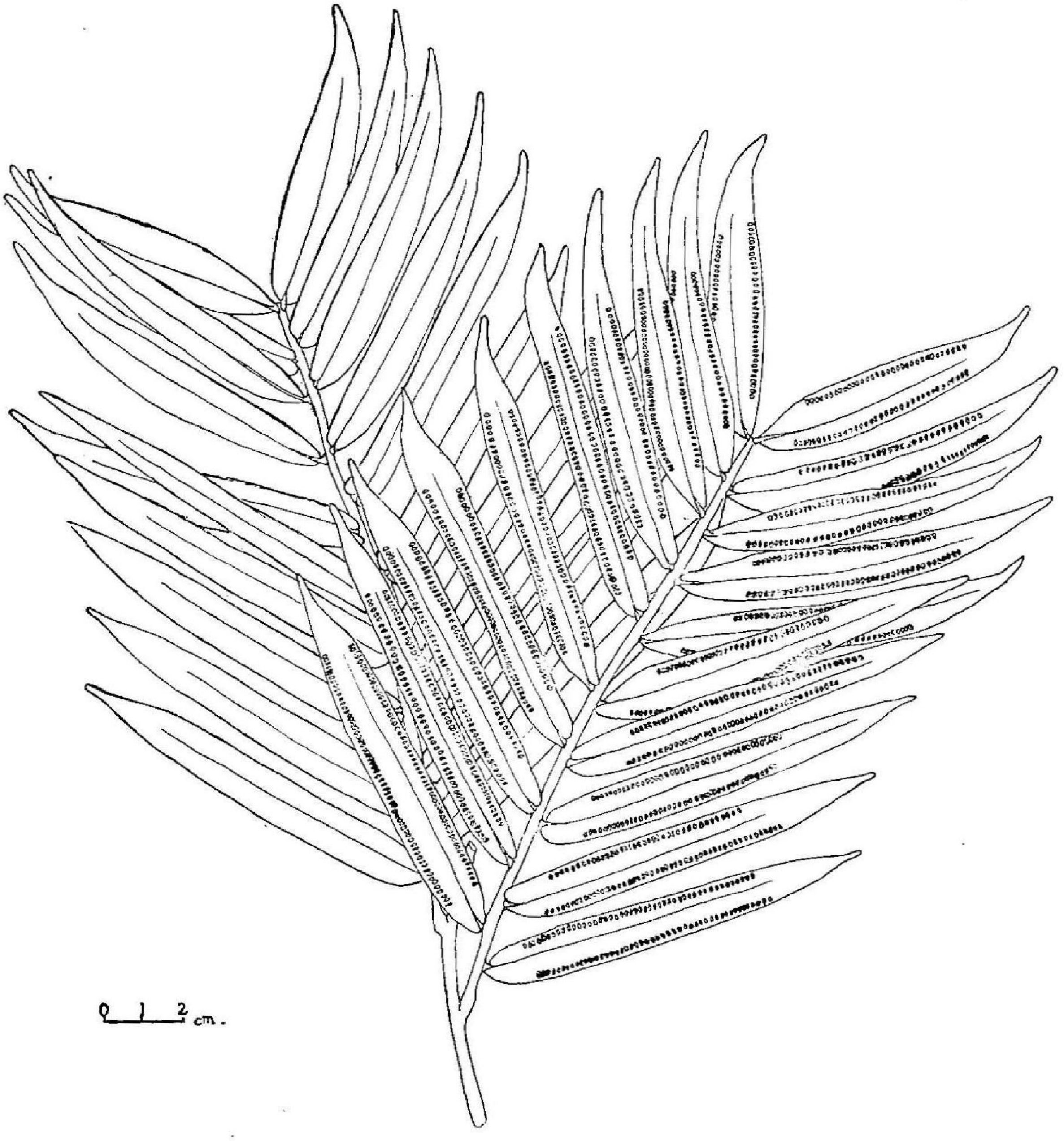

0 1 2 cm.

PLATE III

Angiopteris evecta (Forst.) Hoffm.

A. Fertile pinnule.

B. Sporangium (before dehiscence).

C. Sporangium (after dehiscence).

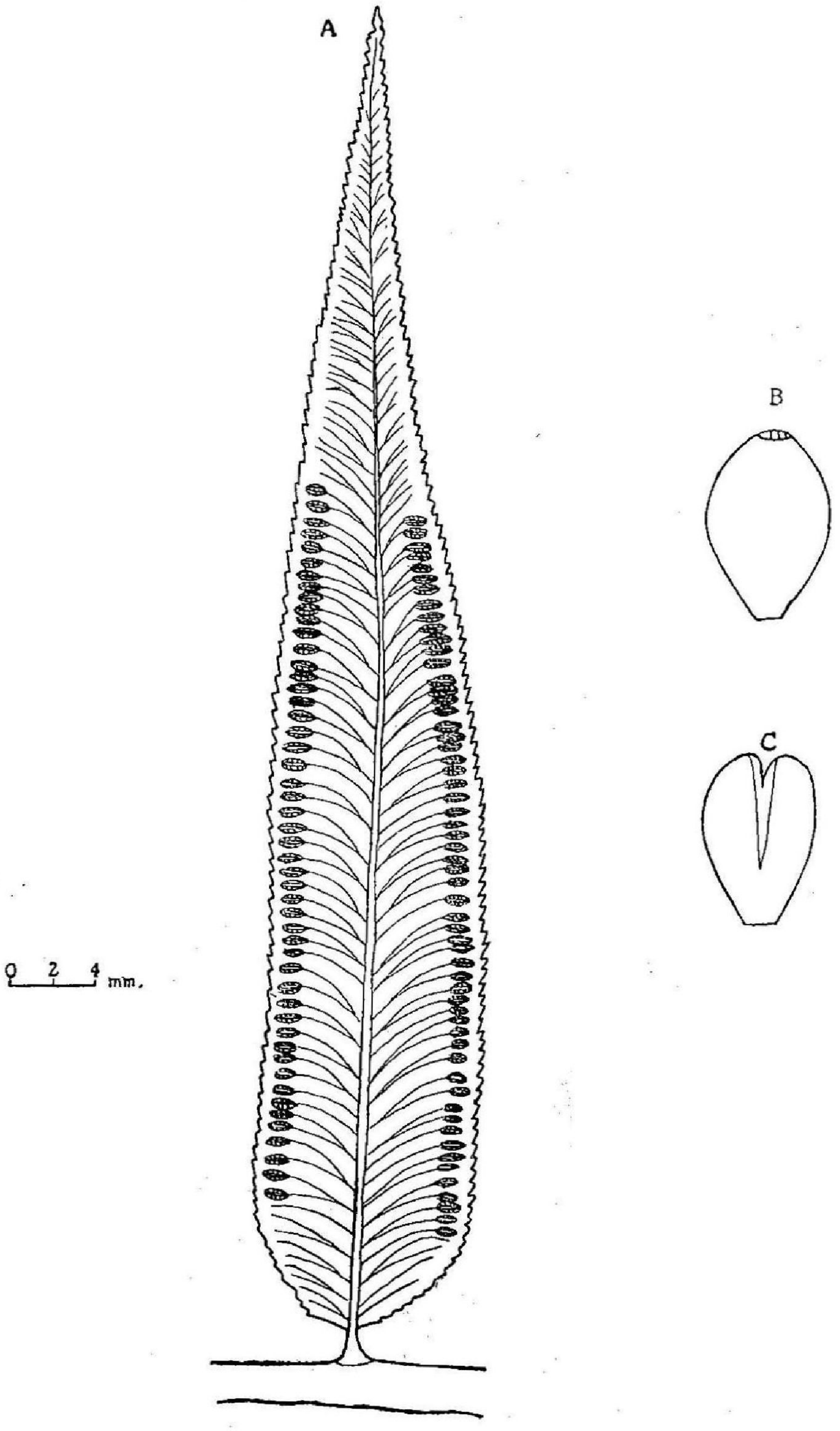

A
B
C
0 2 4 mm.

PLATE IV

Lygodium scandens (L.) Sw.

Young plant.

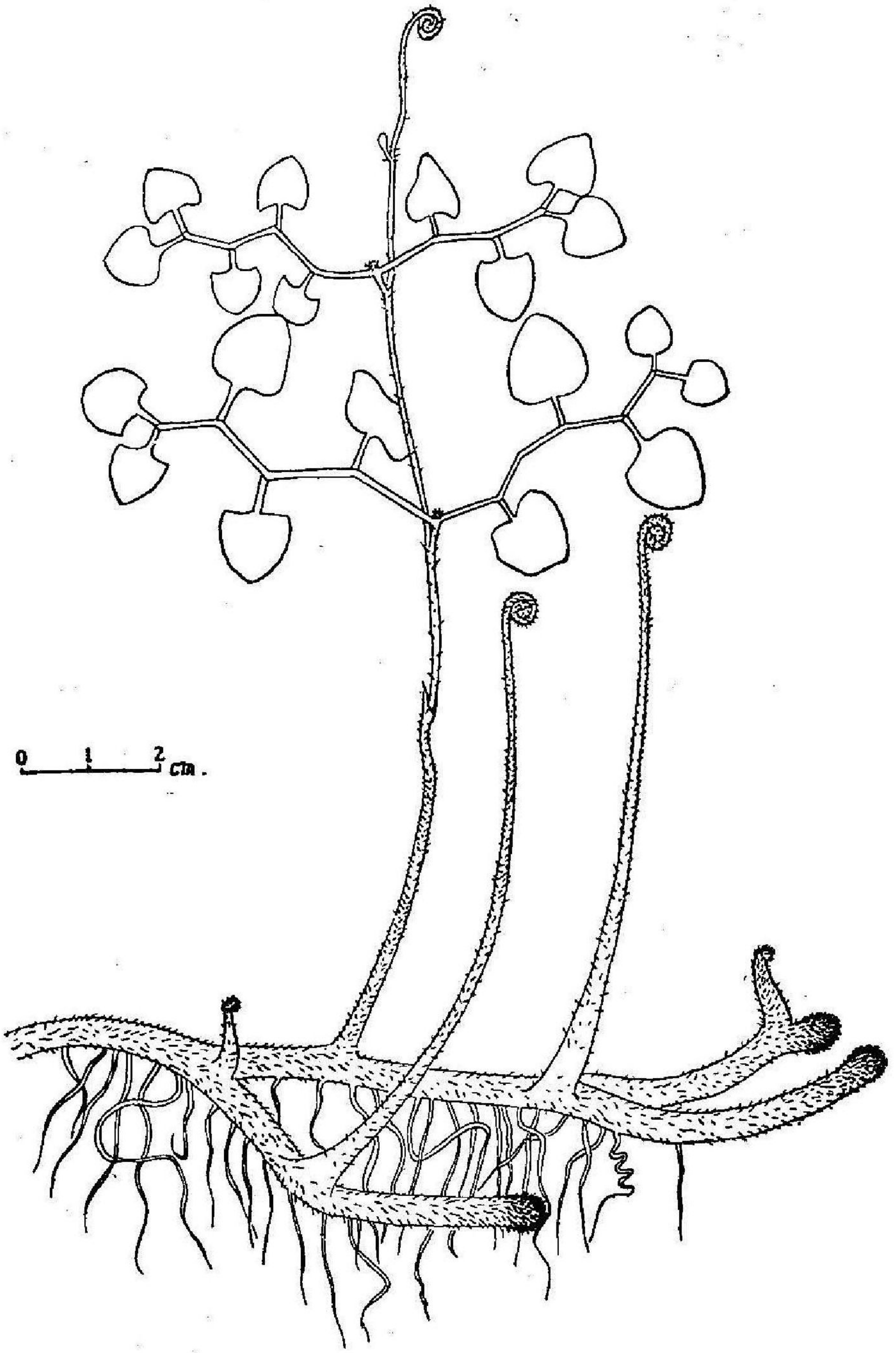

0 1 2 cm.

PLATE V

Lygodium scandens (L.) Sw.

A. Whole plant.

B. Sterilc segments.

C. Fertile segments.

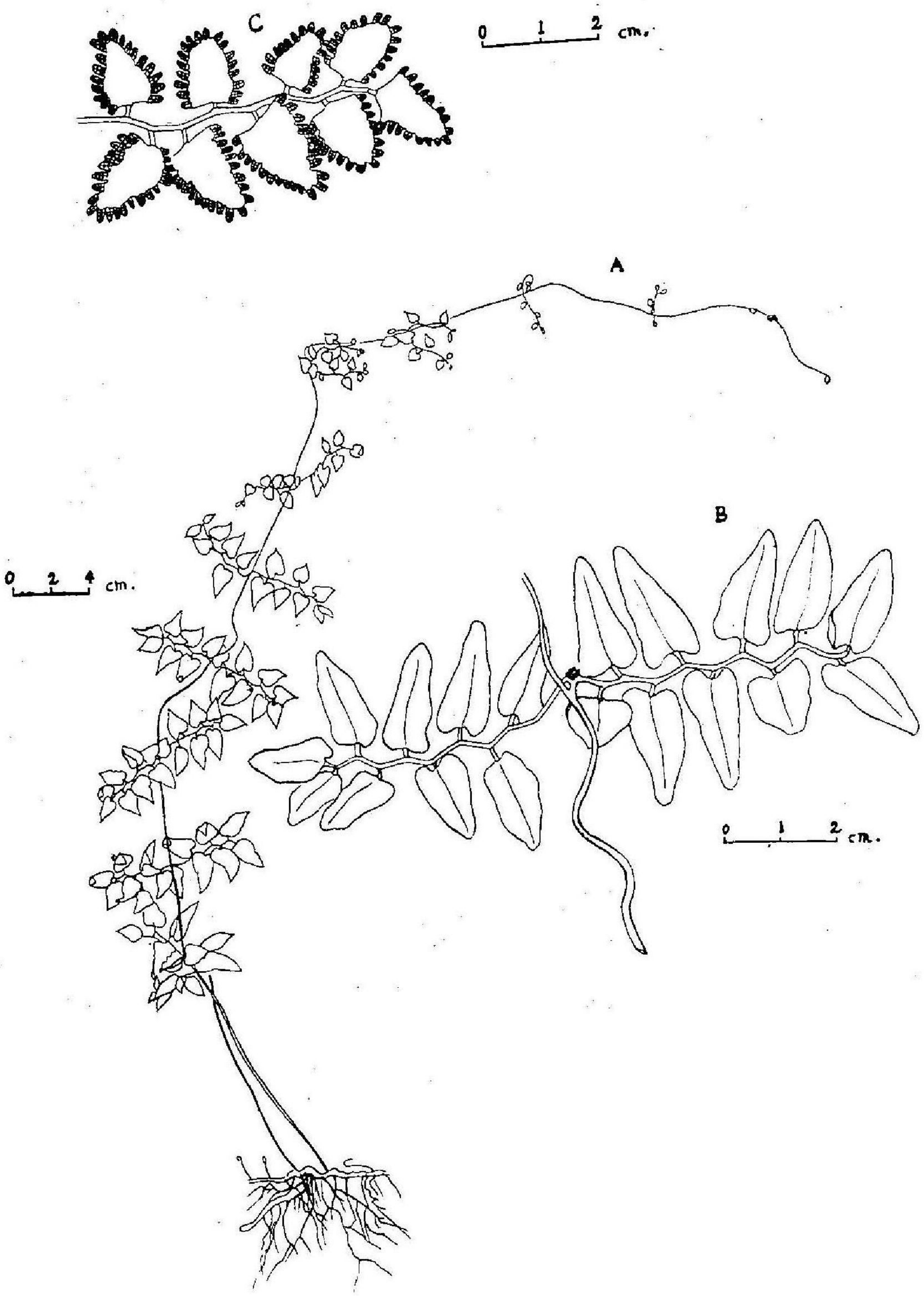

C
0 1 2 cm.
A
B
0 2 4 cm.
0 1 2 cm.

PLATE VI

Lygodium scandens (L.) Sw.

A. Sterile segment.

B. Sorophore.

C. Sporangium.

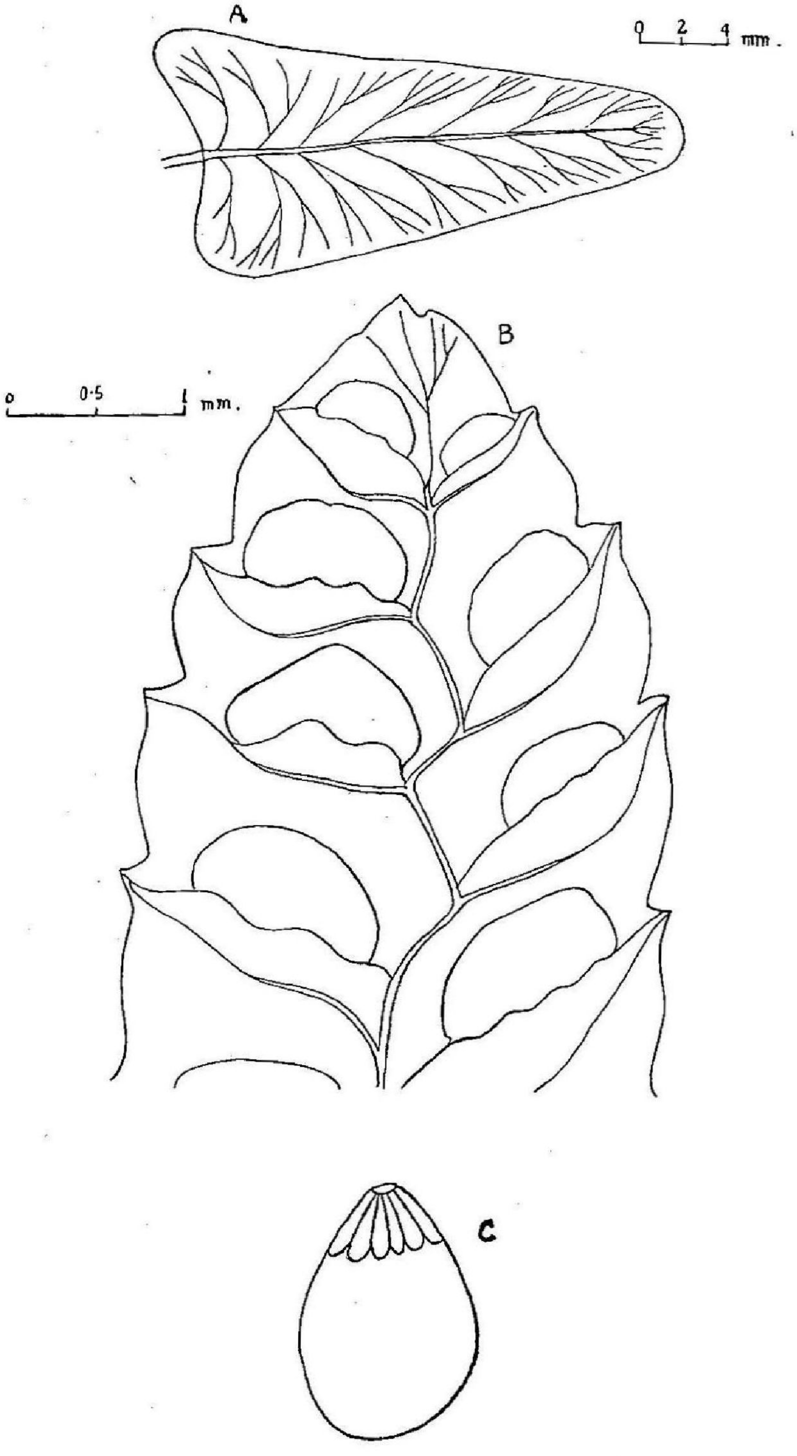

A
0 2 4 mm.
B
0 0·5 1 mm.
C

PLATE VII

Actiniopteris radiata (Sw.) Link.

A. Whole plant.

B. Fertile lamina.

C. Fertile segments.

D. Sporangium.

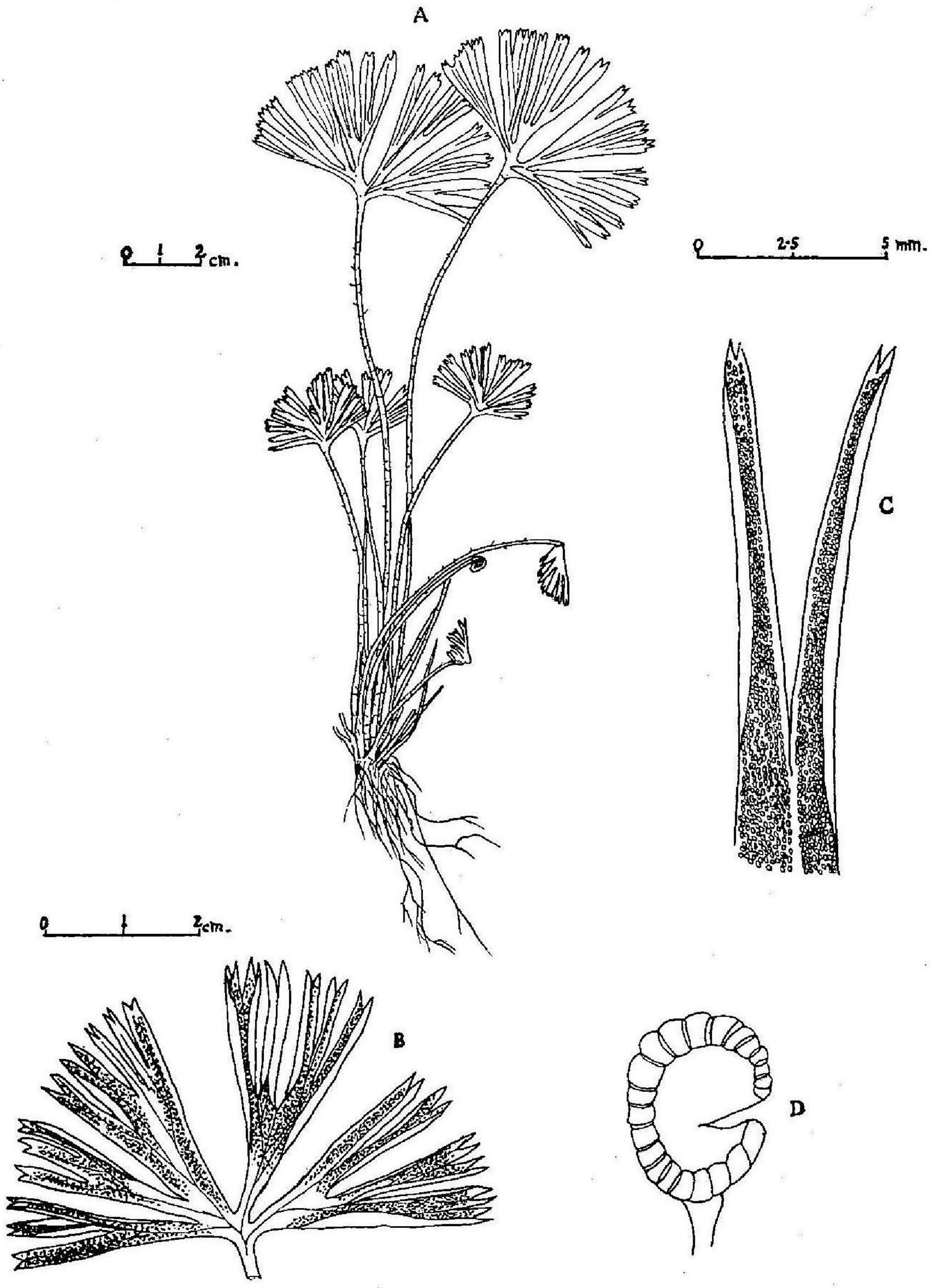

A
0 1 2 cm.
0 2·5 5 mm.
C
0 1 2 cm.
B
D

PLATE VIII

Cheilanthes mysurensis Wall

Whole plant.

PLATE VIII

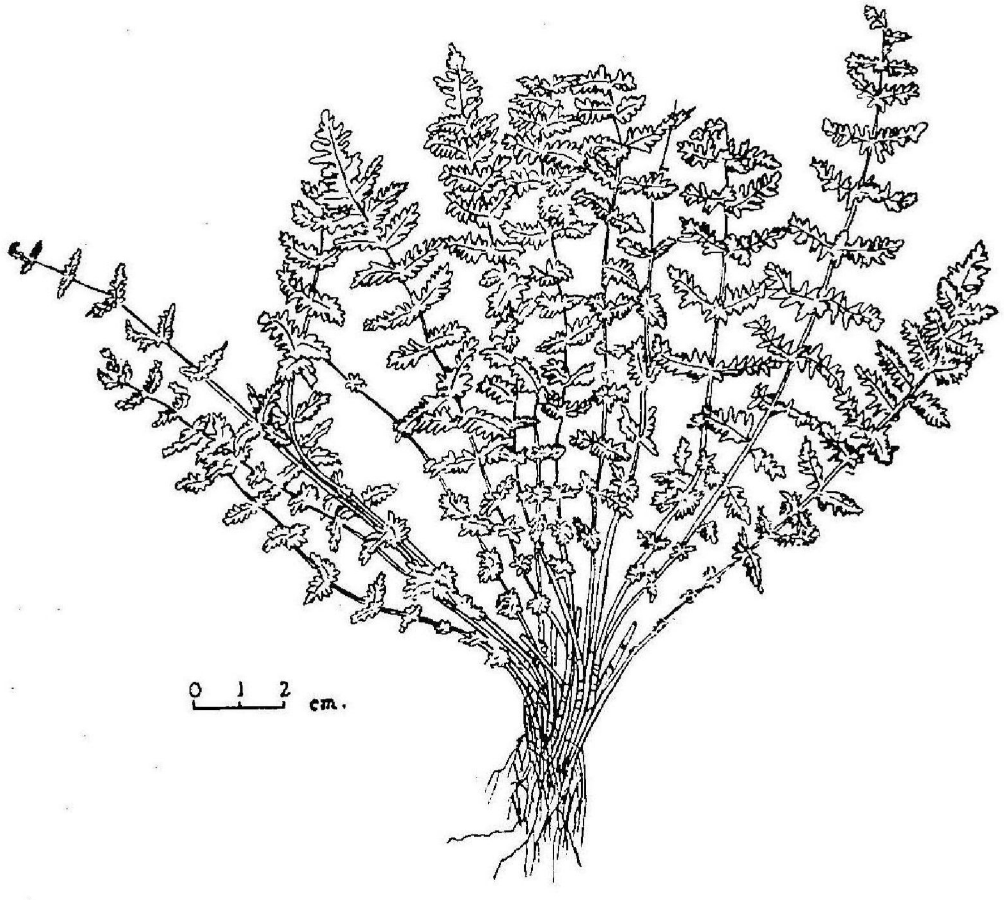


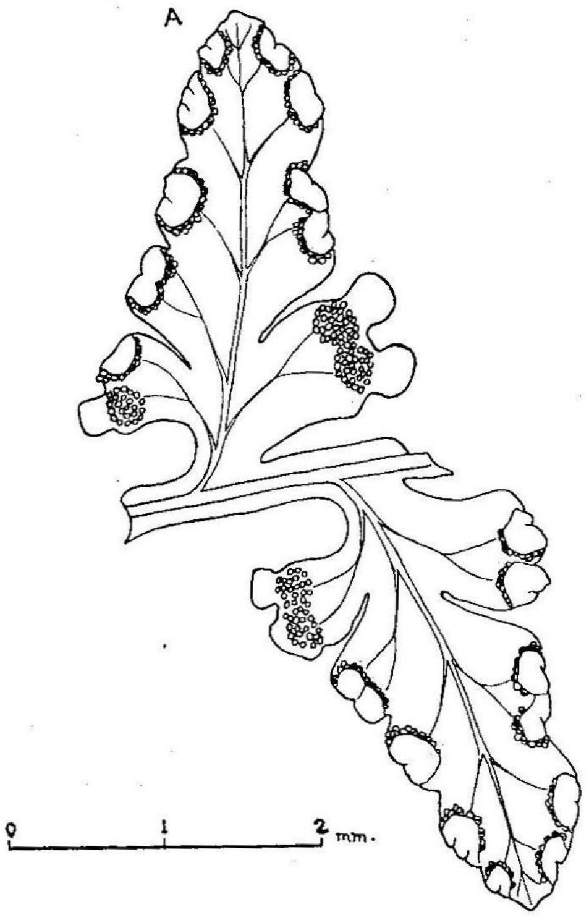
PLATE IX

Cheilanthes mysurensis Wall.

A. Part of fertile frond.

B. Sporangium.

A



B

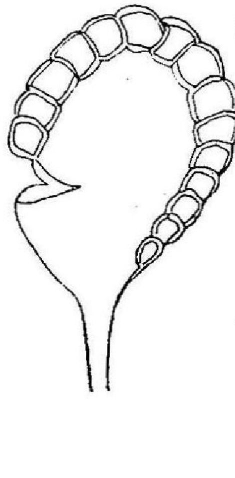


PLATE X

Cheilanthes tenuifolia (Burm.) Sw.

A. Whole plant.

B. Part of frond.

C. Sporangium.

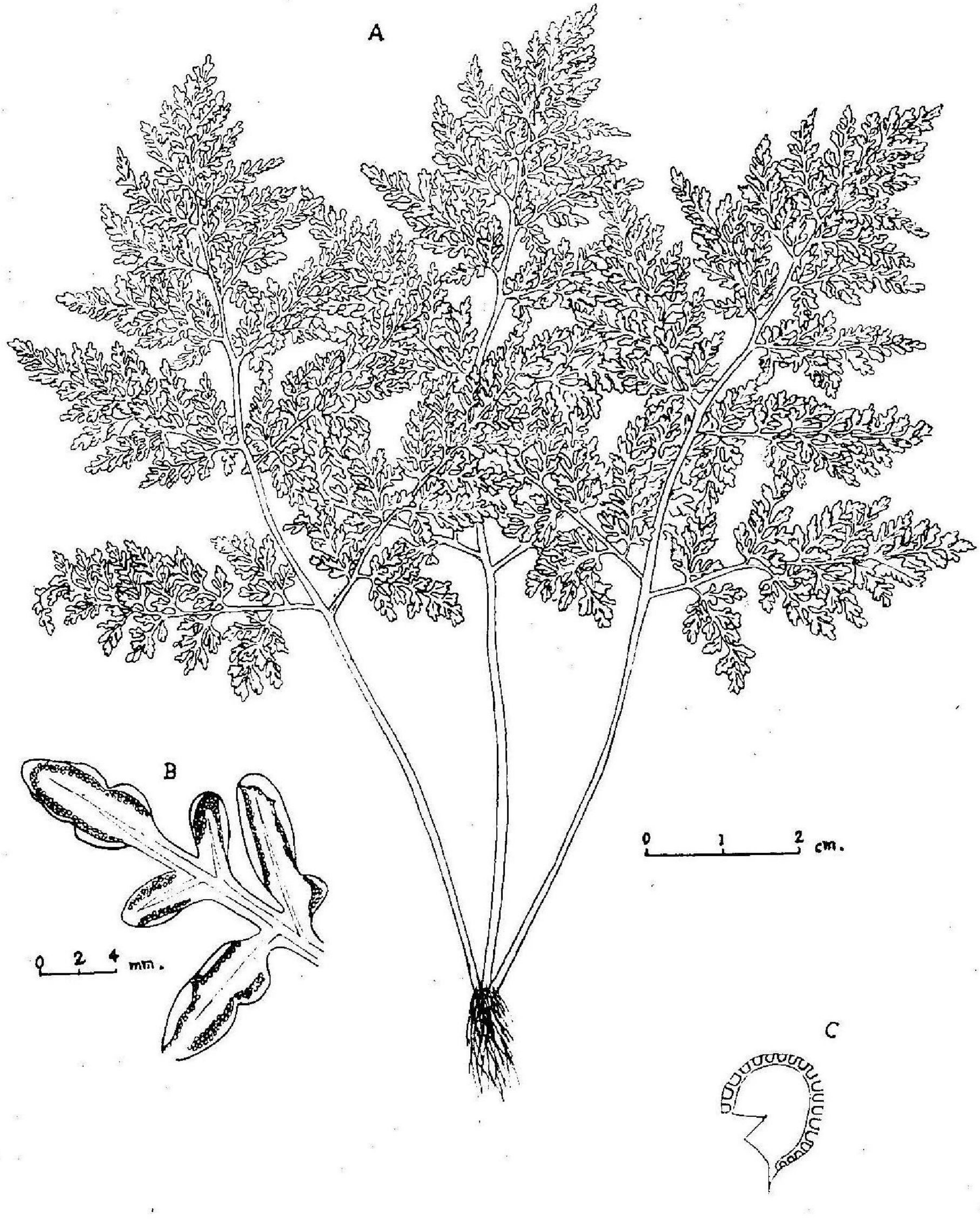

A
B
0 2 4 mm.
0 1 2 cm.
C

PLATE XI

Cheilanthes farinosa (Forsk.) Klf.

A. Whole plant.

B. Part of frond.

C. Sporangium.

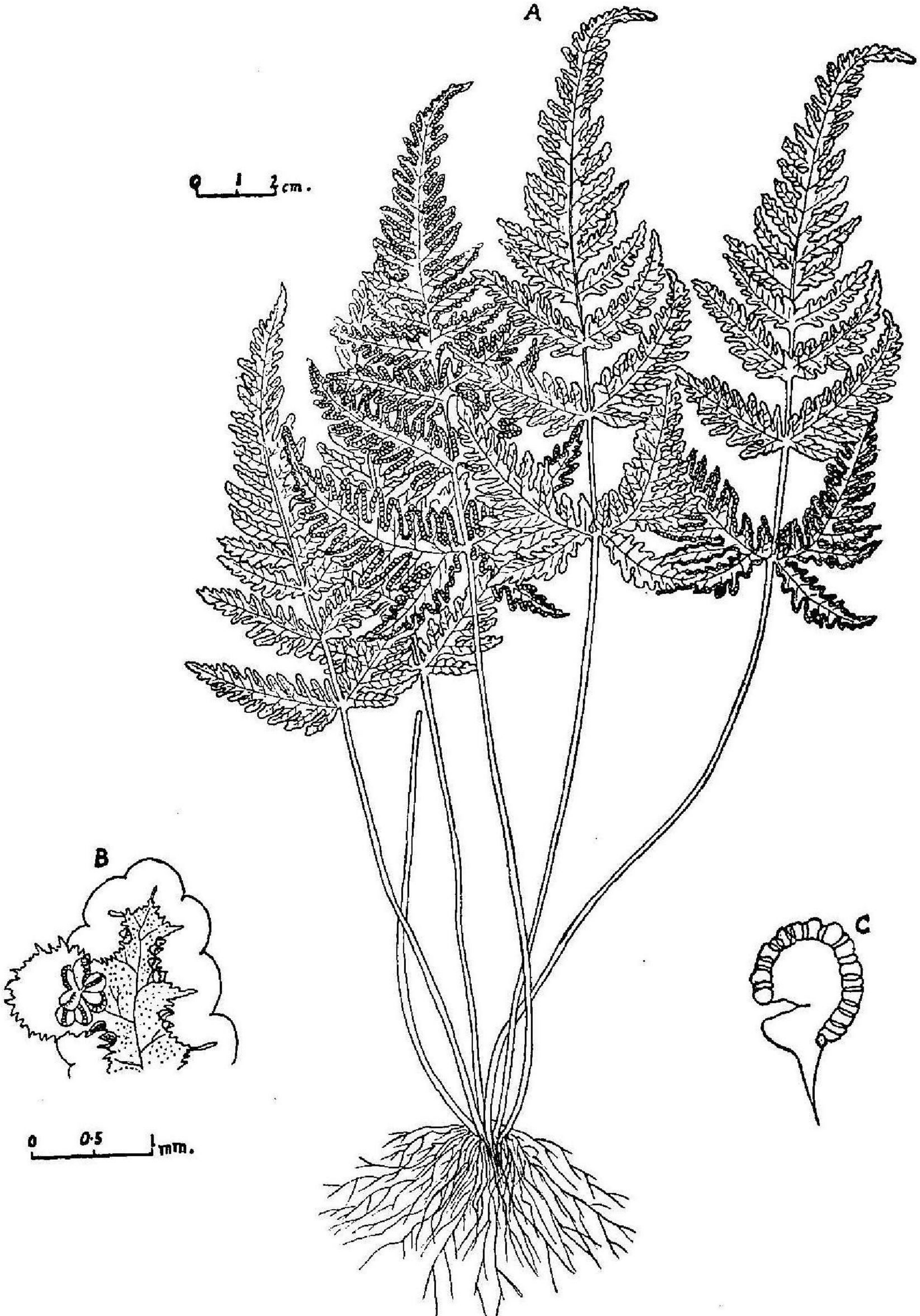

A
0 1 2 cm.
B
0 0.5 mm.
C

PLATE XII

Hemionitis arifolia (Burm.) Moore

A. Whole plant.

B. Part of fertile frond

C. Sprangium.

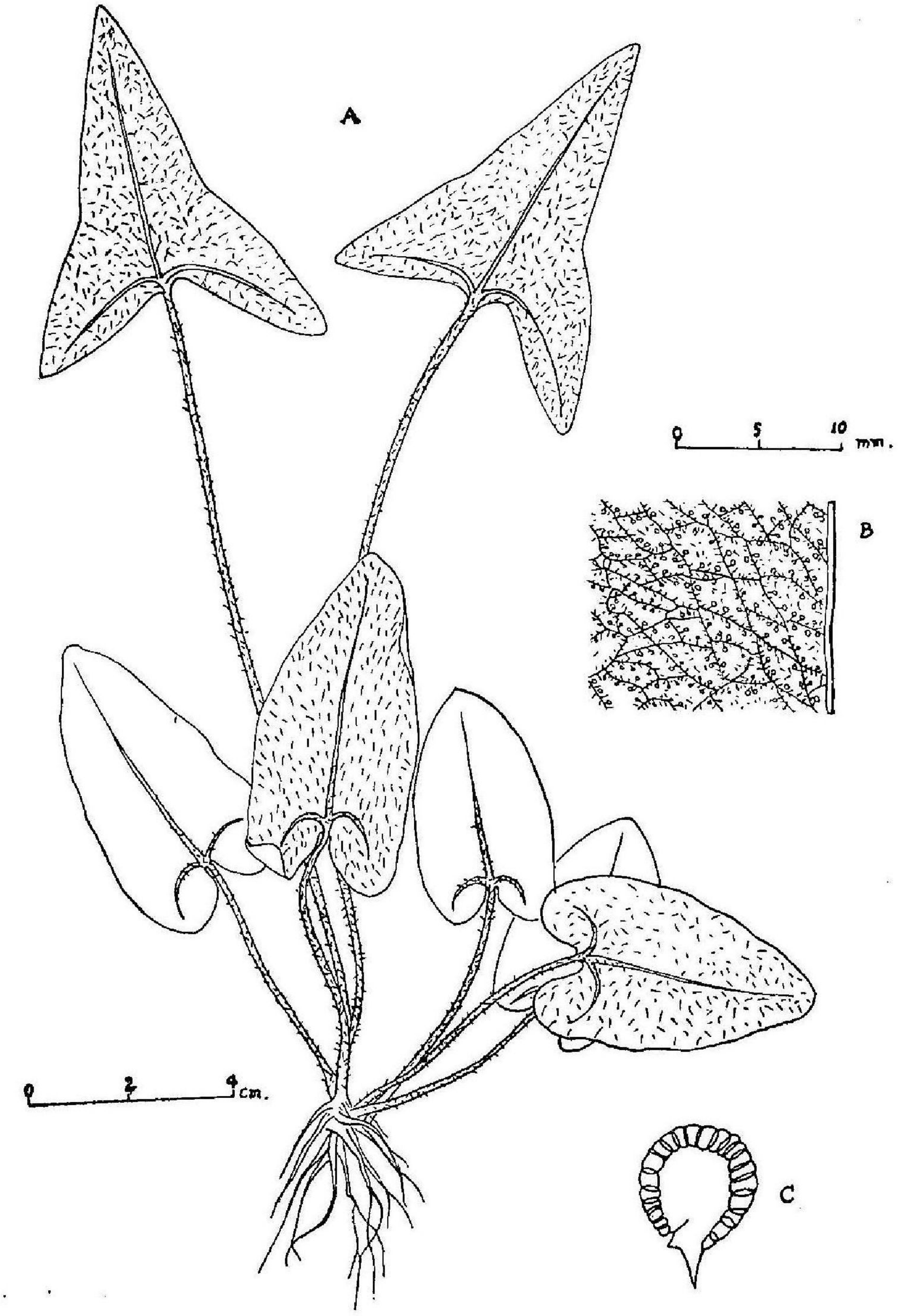

A
0 5 10 mm.
B
0 2 4 cm.
C

PLATE XIII

Adiantum caudatum L

A. Whole plant.
B. Pinna.
C. Sporangium.

0 1 2 mm.
B
C
A
0 1 2 cm.

PLATE XIV

Vittaria elongata Sw.

A. Whole plant (with break in the continuity of leaves)

B. Part of frond (lateral view).

C. Part of frond (sectional view).

E. Sporangium.

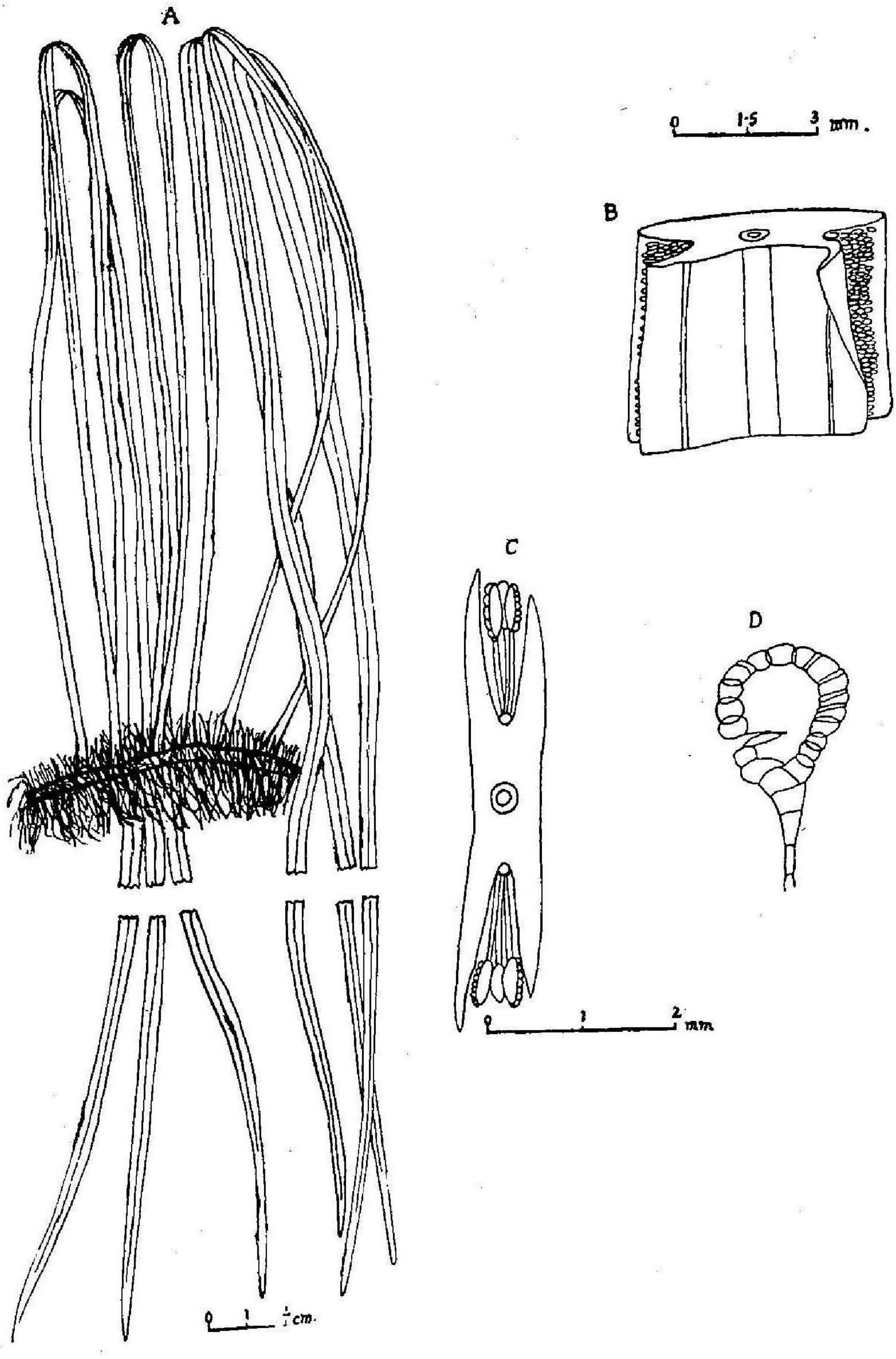

A
0 1·5 3 mm.
B
C
D
0 1 2 mm

PLATE XV

Lindsaea ensifolia Sw.

A. Whole plant.

B. Part of frond.

C. Sporangium.

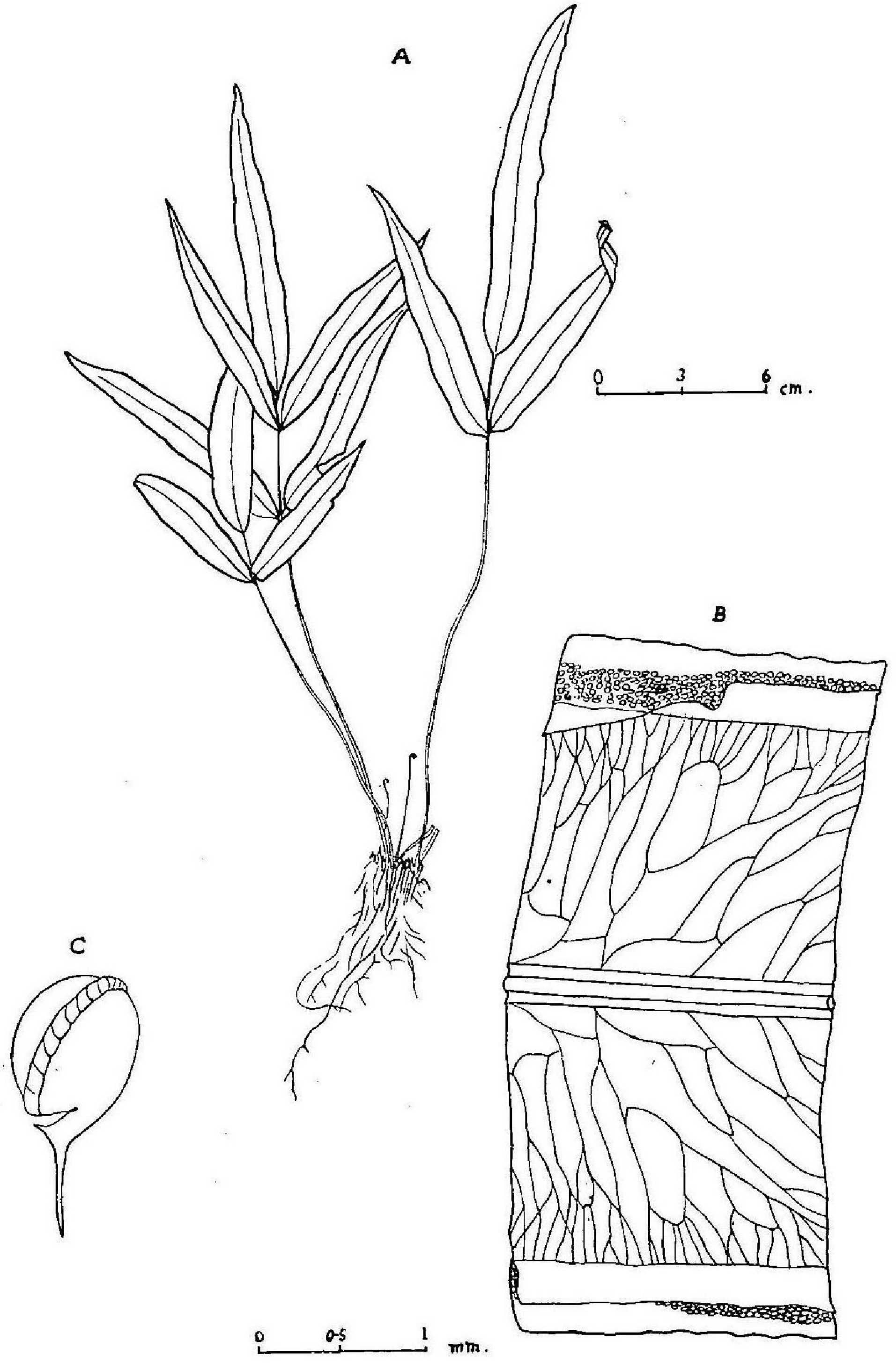

A
0 3 6 cm.
B
C
0 0·5 1 mm.

PLATE XVI

Dicranopteris linearis var. linearis

Young plant.

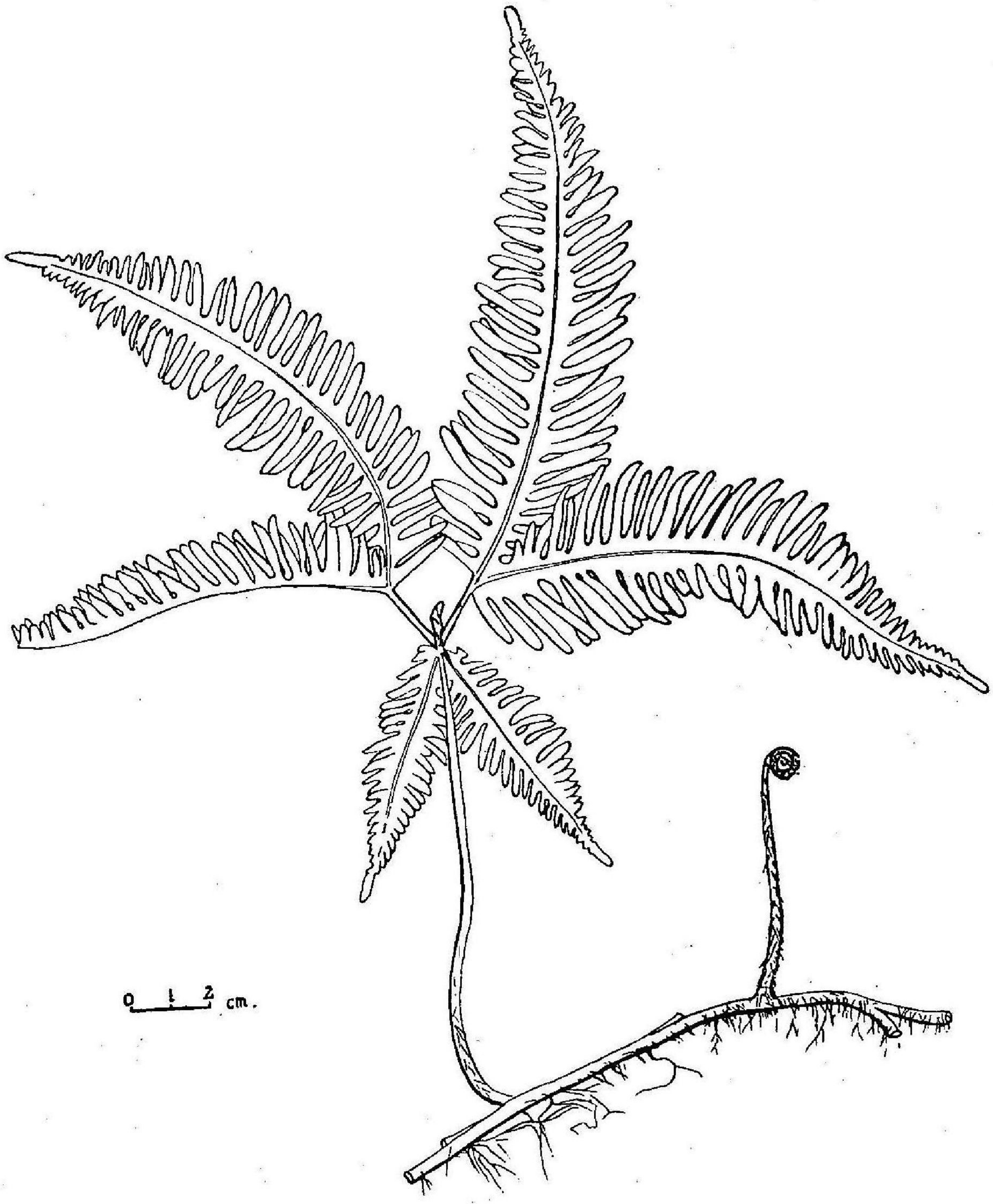

0 1 2 cm.

PLATE XVII

Dicranopteris linearis var. **linearis**

A. Part of frond.

B. Fertile lobe.

C. Sporangium (before dehiscence).

D. Sporangium(after dehiscence).

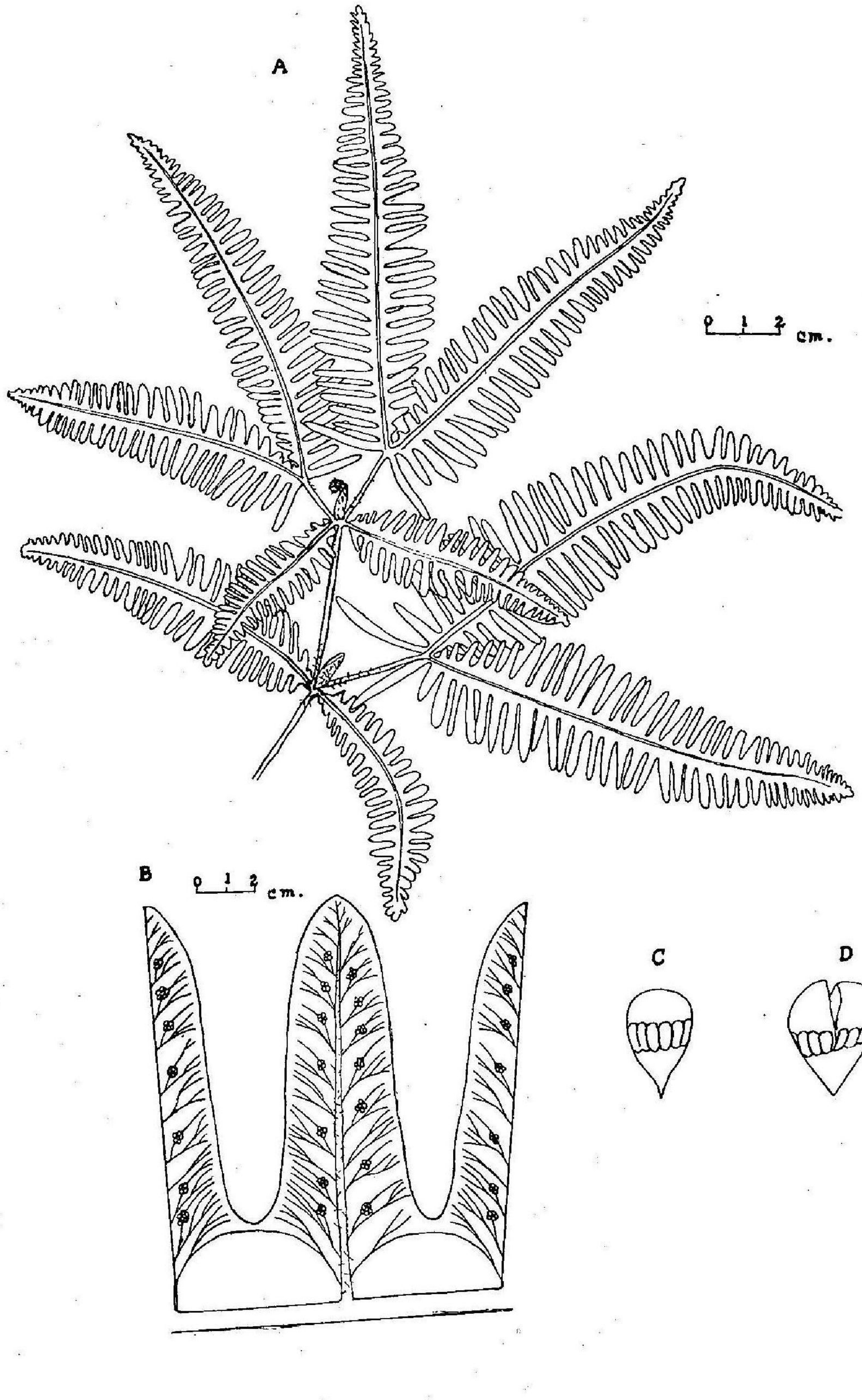

A
0 1 2 cm.
B
0 1 2 cm.
C
D

PLATE XVIII

Blechnum orientale L.

A. Whole plant (young).

B. Part of stipe.

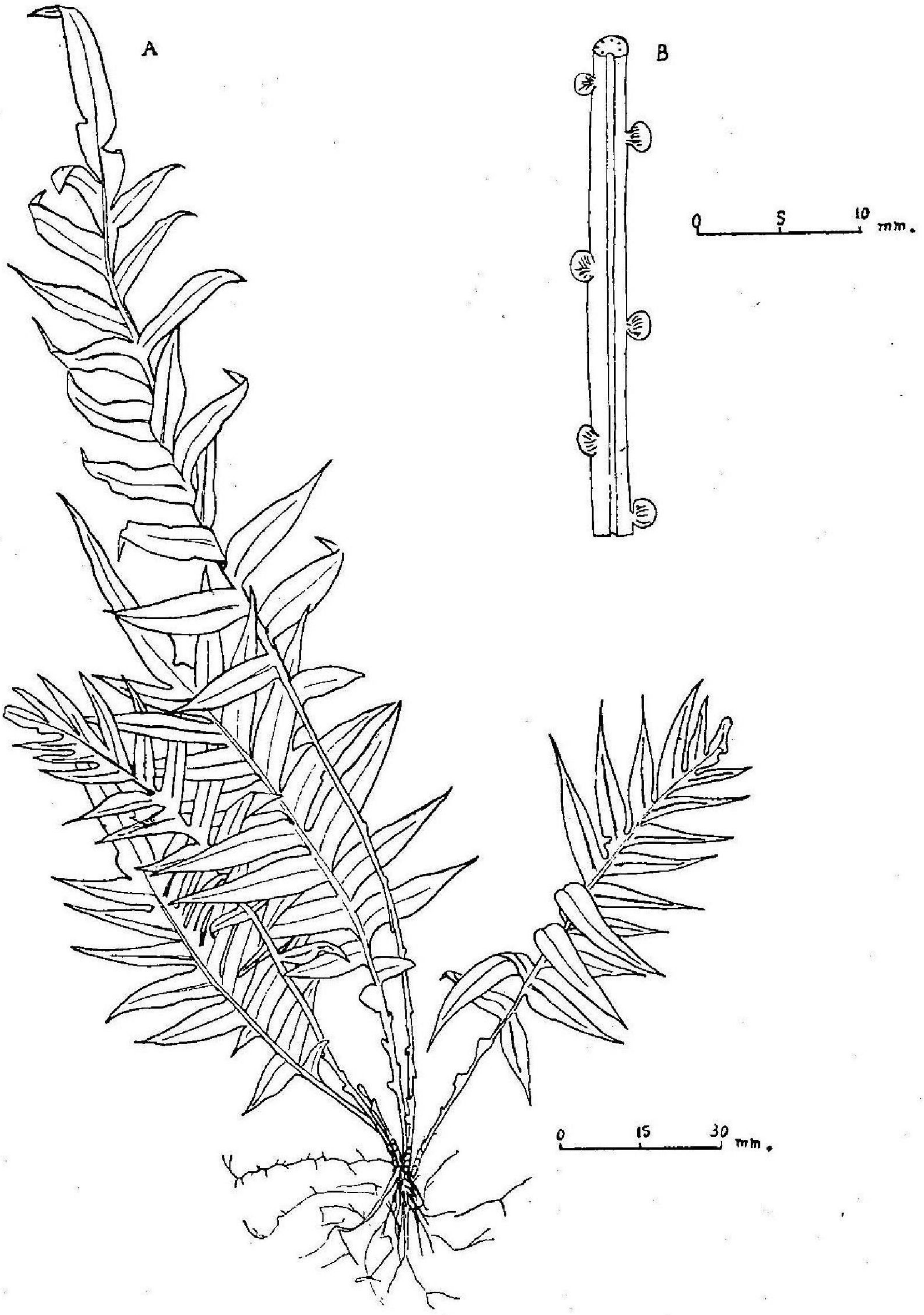

A
B
0 5 10 mm.
0 15 30 mm.

PLATE XIX

Blechnum orientale L.

Part of frond.

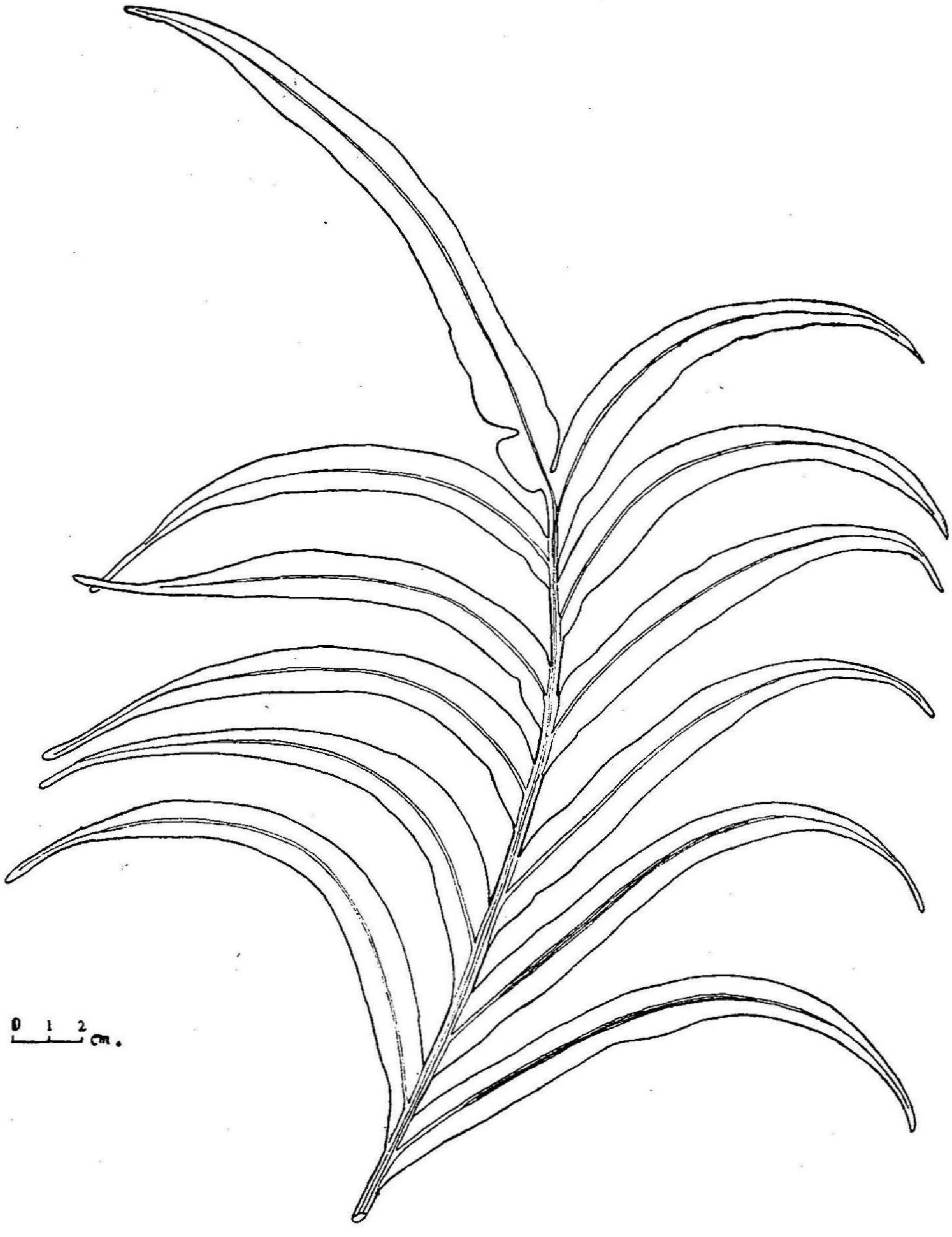

0 1 2 cm.

PLATE XX

Blechnum orientale L.

A. Fertile pinna.

B. Sporangium.

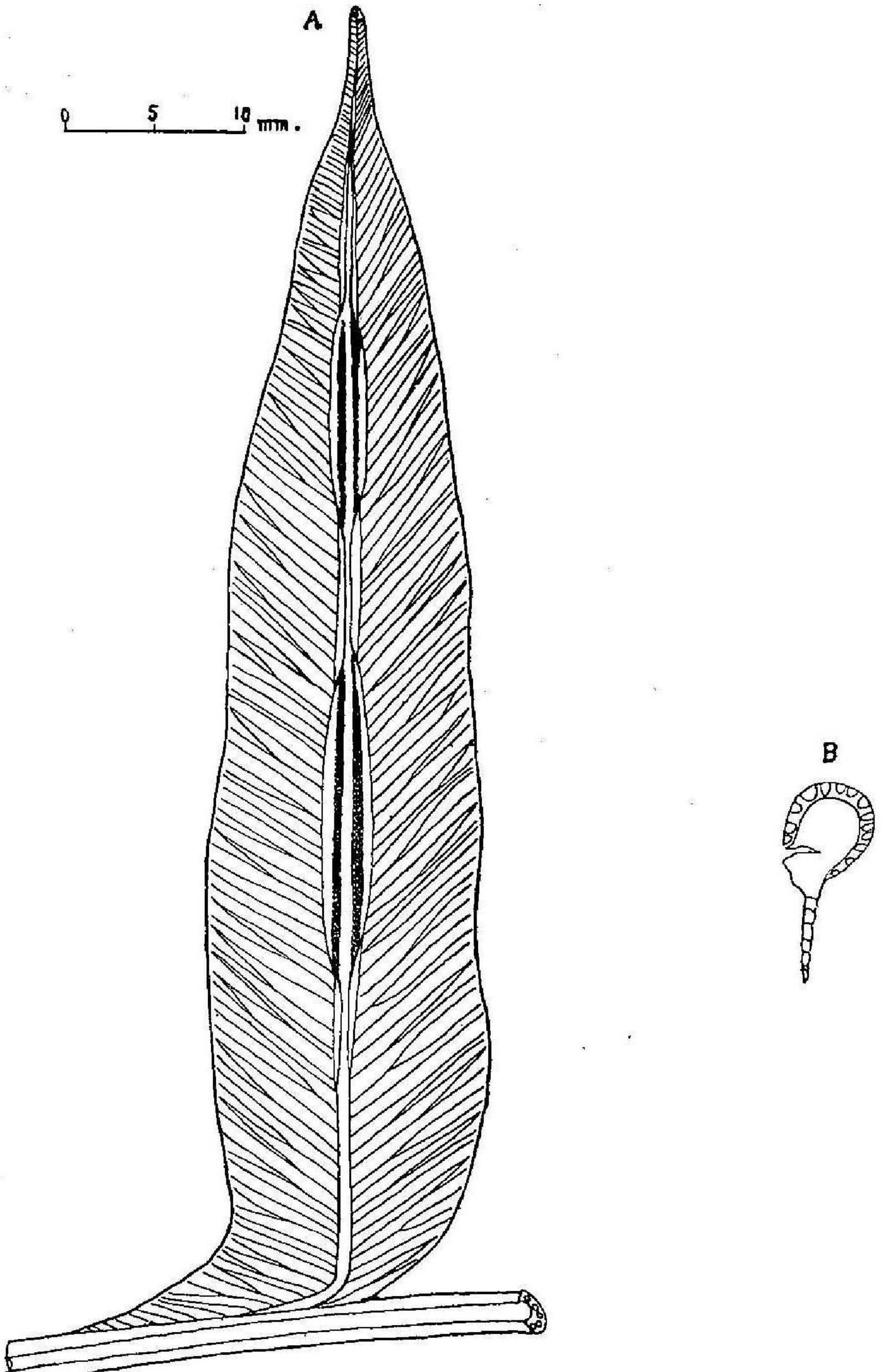

A
0
5
10 mm.
B

PLATE XXI

Pleopeltis linearis (Thunb.) Bedd.

A. Whole plant.

B. Part of frond.

C. Sporangium.

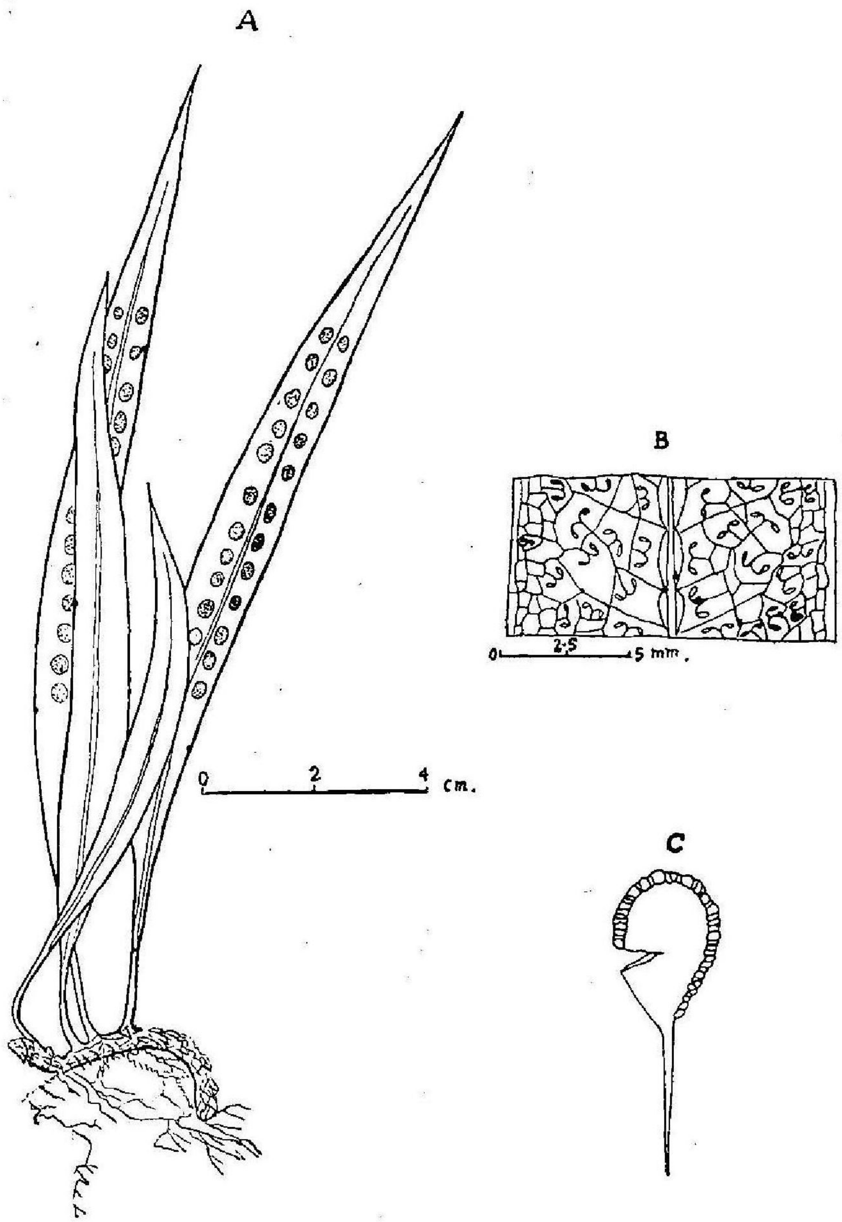

A
B
0 2·5 5 mm.
0 2 4 cm.
C

PLATE XXII

Marsilea sp.

A. Whole plant.

B. Sterile frond.

C. Sorophore.

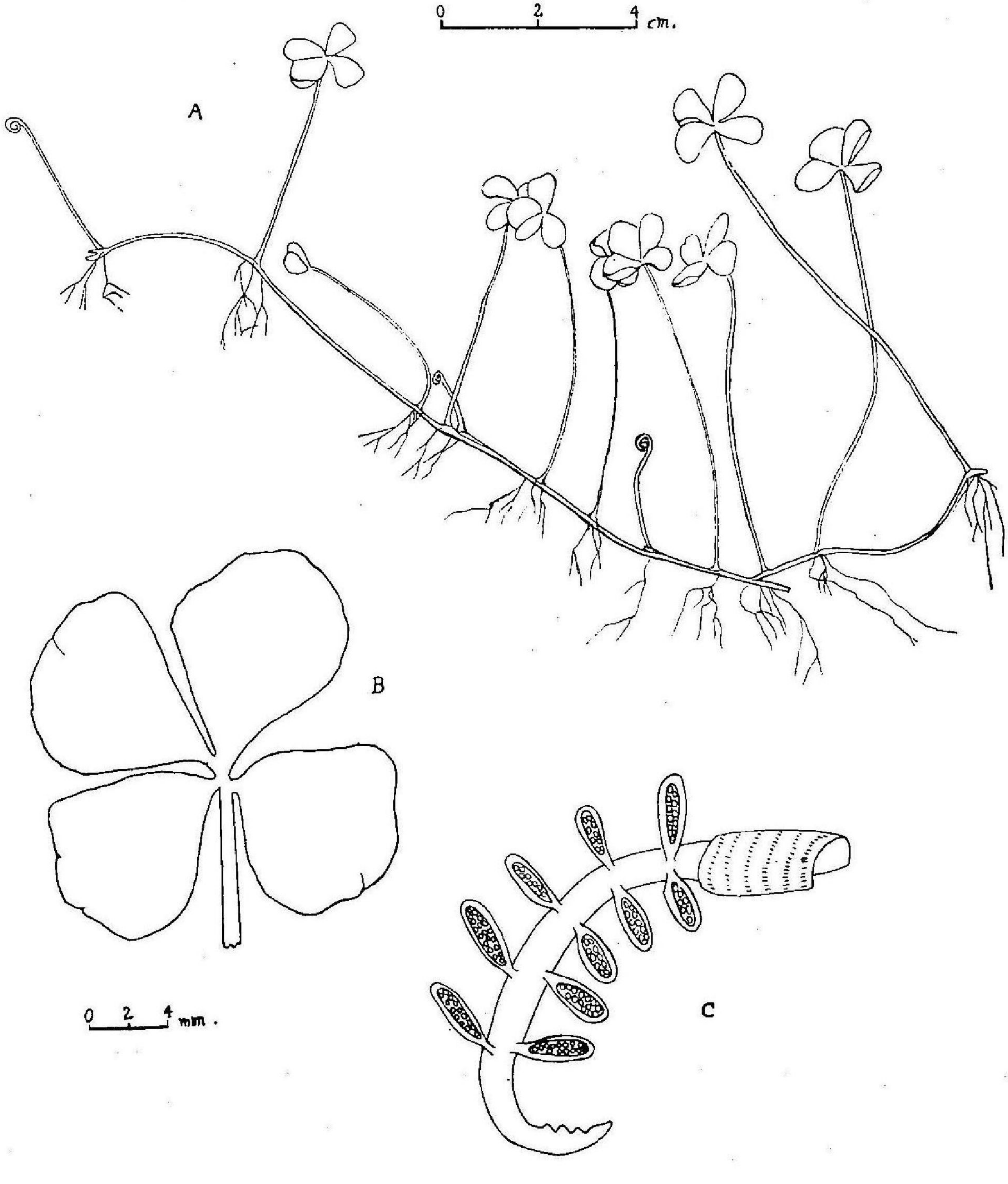

0 2 4 cm.
A
B
0 2 4 mm.
C

PLATE XXIII

Marsilea minuta L.

A. and B. Whole plants without sporocarps.

C. Whole plant with sporocarps.

D. Whole plant with sporocarps but without fronds.

E. and F. Sporocarps.

PLATE XXIII

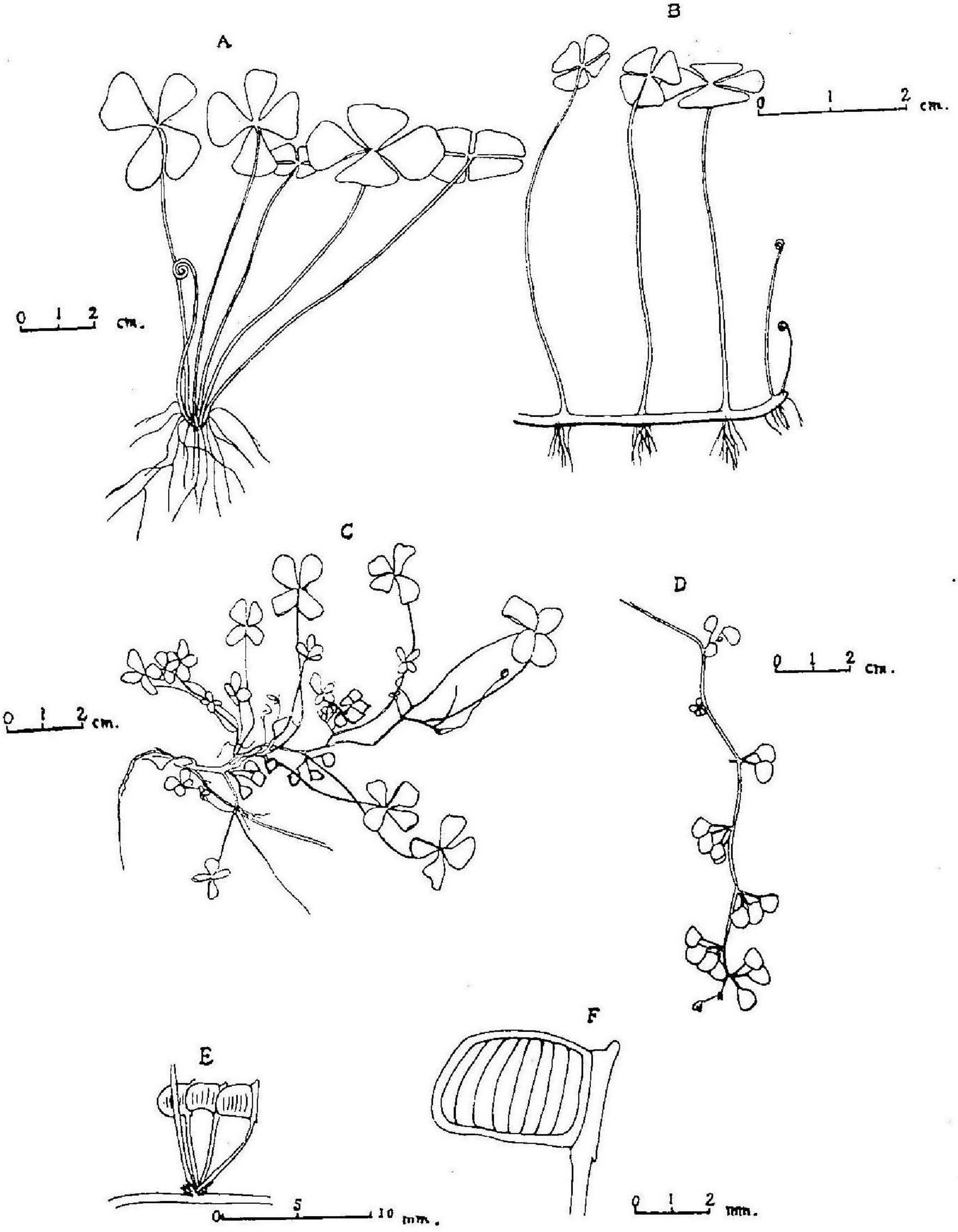
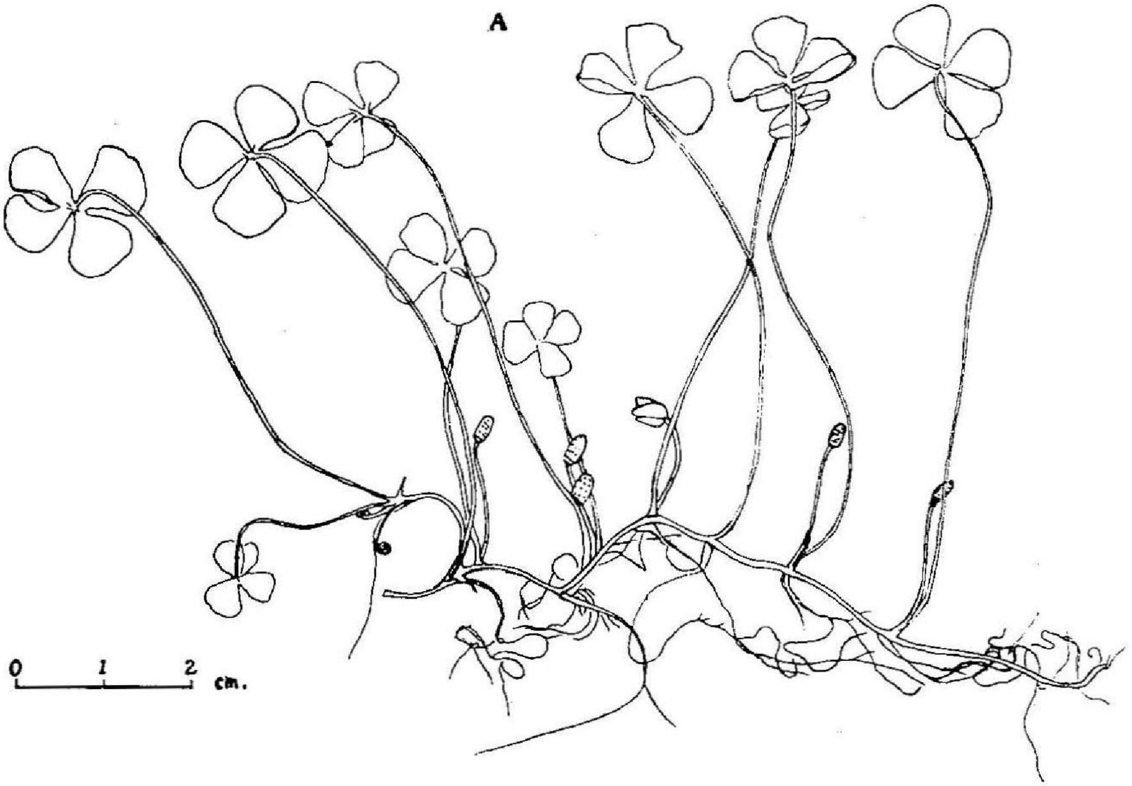


PLATE XXIV

Marsilea coromandelica Burm f.

A. Whole plant.

B. Sporocarp.


A
0
1
2
cm.

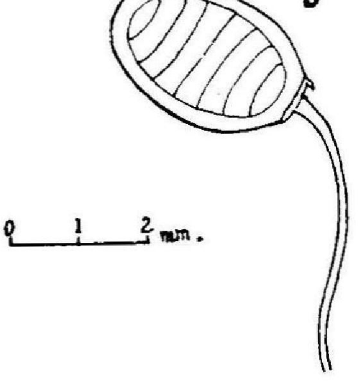

B
0
1
2
mm.

PLATE XXV

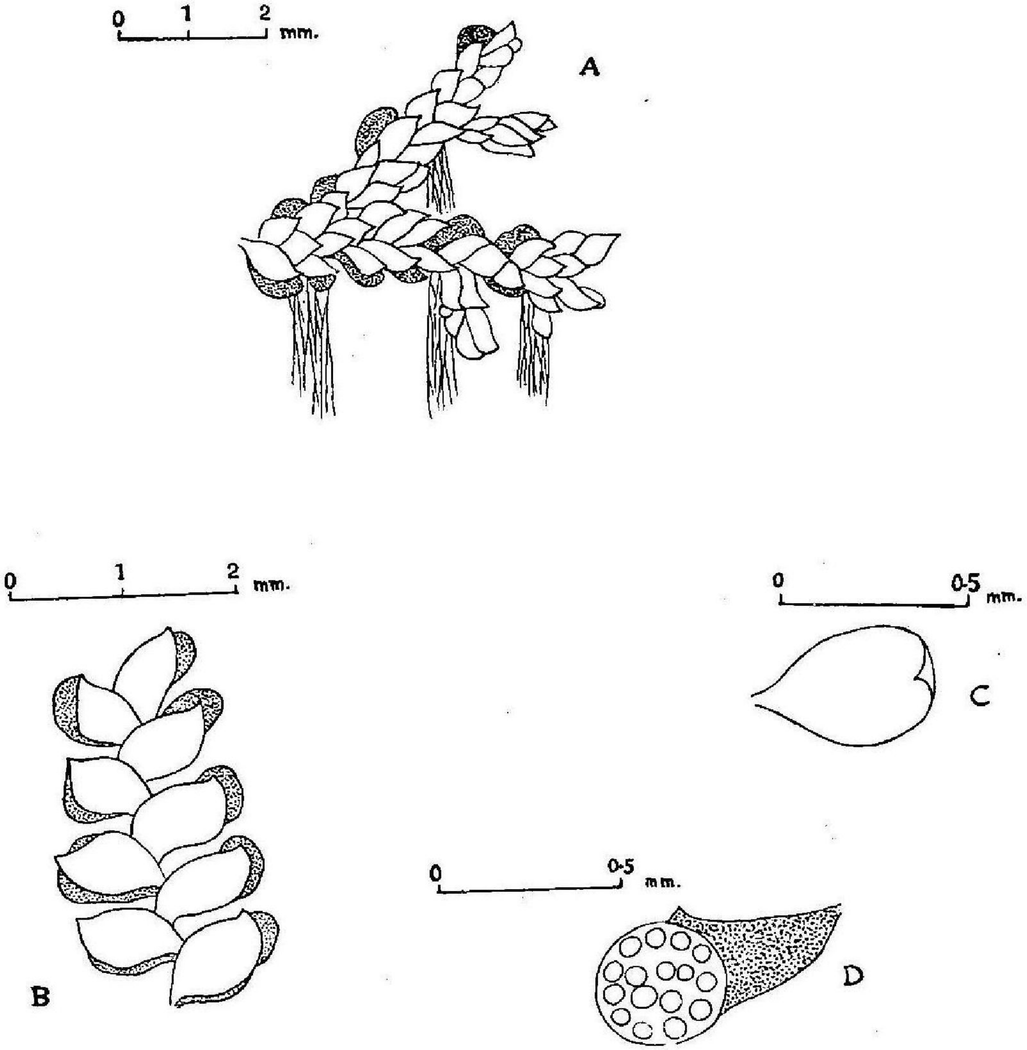
Azolla pinnata R. Br.

A. Whole plant.

B. Branch.

C. Upper floating lobe of frond.

D. Lower submersed lobe of frond with a sporocarp.


0 1 2 mm.
A
0 1 2 mm.
B
0 0·5 mm.
C
0 0·5 mm.
D

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31	43	3.5	3·5
34	33	2.5	2·5
38	5	Kze.	Kze.,
39	41	inter-connectcd	inter-connected

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